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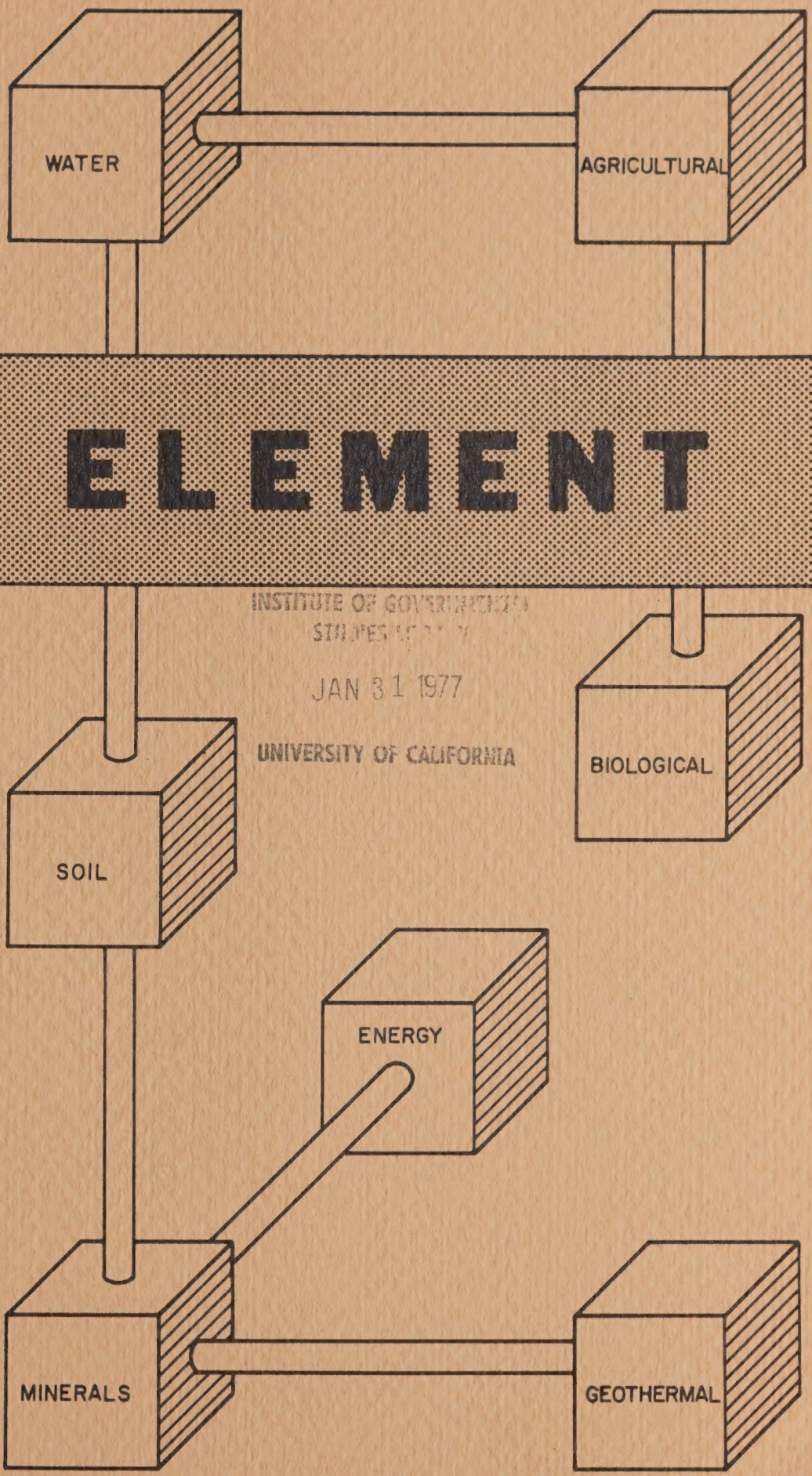
CONSERVATION ELEMENT



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CONSERVATION ELEMENT

....an element of the Imperial County General Plan

County planning Imperial co.
Conservation

Adopted December 18, 1973

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TABLE OF CONTENTS

CHAPTER		Page
I.	CONSERVATION ELEMENT	1
	Introduction	1
	Legislative Requirements	2
	Areas of Statewide Significance or Critical Concern	6
	Implementation	7
	Goals and Objectives	9
	Land-Use Suitability	11
II.	WATER RESOURCES	13
	Issues	13
	Objectives	13
	Resource Demand	13
	Surface Water	16
	Groundwater	24
	Irrigation Water	29
	Conservation	31
	Policies	33
III.	LAND RESOURCES	35
	Geologic Factors	35
IV.	LAND RESOURCES - MINERALS	37
	Issues	37
	Objectives	37
	Mineral Resource Potential	37
	Sand and Gravel Resources	39
	Land - Use Conflict	42
	Environmental Considerations	42
	Policies	45

V. LAND RESOURCES - SOILS 46

Issues 46
Objectives 46
Soil Characteristics 46
Soil Capabilities 48
Limitations on Land - Use 52
Policies 53

VI. LAND RESOURCES - AGRICULTURAL LANDS 55

Issues 55
Objectives 55
Resource Potential 55
Agricultural Soils 56
Agricultural - Urban Conflict 58
Policies 60

VII. ENERGY RESOURCES 61

Issues 61
Objectives 61
Resource Demand 62
Energy Resources 63
Transmission Facilities 67
Energy Conversion and Conservation 67
Policies 68

VIII. GEOTHERMAL RESOURCES 69

Issues 69
Objectives 69
Geologic Factors 69
Resource Potential 71
Environmental Considerations 73
Policies 77

IX. BIOLOGICAL RESOURCES 79

Issues 79
Objectives 79
Resources or Resource Areas of Statewide Significance or Critical Concern 79
Wildlife Resources and Habitat Areas 80
Policies 89

X. REFERENCES 91

CHAPTER I. CONSERVATION ELEMENT

INTRODUCTION

The environmental movement that has matured in the past several years may be considered to have either a detrimental or beneficial effect upon the quality of life in America. Those who support the movement deplore the lack of foresight characteristic of some resource policy decisions. Others argue that the growth and development of the American economy are the primary determinants of the quality of life. Extreme positions at both ends of the spectrum undoubtedly exist. The goal, however, is not to return to a pre-industrial rural lifestyle nor to develop all our available resources, but rather to develop and implement a sensible plan for their utilization and conservation. In many cases the resource base is finite and unrenewable. Waste or destruction of these resources reduce the range of opportunities available to this and future generations. An example of positive action to conserve limited natural resources is the installation of tile drains to curtail increasing salt concentration in local soils, permitting agricultural land in the County to remain productive. If these measures had not been implemented, the salt concentrations would have resulted in several significant impacts. The soil could have become totally unproductive, or at best the variety of crops grown would have been severely reduced. Excessive quantities of water would also have been required to attempt to maintain productivity, compounding the problem of quality water supply in the Southwest.

The Conservation Element attempts to assure that natural resources are conserved or utilized according to the intrinsic characteristics of each. This generation is the present caretaker of these resources for all future generations. These resources should be utilized or conserved according to plans that will enhance and assure their long-term availability.

An awareness of the importance of a sound resource management program is developing, prompted by a general planning process concerned with the identification and analysis of the natural resource characteristics of the area. Land-use decisions, based in part upon these factors, have significant, identifiable effects upon the physical, social, economic, and environmental character of the County. Although the process must be concerned with longer range goals and objectives, attention is focused upon relevant problems which currently exist or which will evolve in the near future unless appropriate precautionary measures are taken. This problem-oriented approach will enable the County to face issues which are of concern today for the purpose of avoiding, or at least buying time to study and develop means to alleviate, future problem areas. The Conservation Element identifies the County's natural resources and provides appropriate management policies for their utilization or preservation.

LEGISLATIVE REQUIREMENTS

Legislation. The California State Legislature in 1970-71 amended the State Planning Law to require direct participation by local governments in the protection and enhancement of environmental resources. The State of California Government Code, Title 7, Section 65302 (d) requires that a Conservation Element be prepared as part of all city and county General Plans:

" . . . for the conservation, development, and utilization of natural resources including water and it's hydraulic force, forests, soils rivers and other waters, harbors, fisheries, wildlife, minerals, and other natural resources. . . . The Conservation Element may also cover:

1) The reclamation of land and waters.
2) Flood control.
3) Prevention and control of the pollution of streams and other waters.
4) Regulation of the use of land in stream channels and other areas required for the accomplishment of the conservation plan.
5) Prevention, control, and correction of the erosion of soils, beaches, and shores.
6) Protection of watersheds.
7) The location, quantity, and quality of the rock, sand and gravel resources."

Any project or application undertaken or approved by a local governing body must conform to the Conservation Element of the appropriate General Plan.

Effect. The legislated requirements place a severe burden upon local governments to provide a rational program of natural resource identification, protection, and management. Irregardless, the County must recognize the significance of the legislative intent. A program for the development of an information base to provide a framework for rational environmental planning is essential. Locally elected and appointed officials, as well as functional departments, must be able to make policy decisions based upon reliable information. The essential character of county planning is that it is a continuous process. The goals, objectives, needs and opportunities available change through time, making the attainment of an "ultimate end state" impossible and indeed undesirable. The development of a comprehensive environmental data base should be a priority program within the County.

Although some information is available in published reports, there is a paucity of reliable, in depth, data. The program should draw upon all available expertise, including Federal and State agencies as well as local governments and special districts. One potentially valuable source of information is the university community. Educational institutions should be encouraged to promote research projects and studies relevent to the resource information needs of the County.

Applicability. The Conservation Element applies to all unincorporated land within the County; each incorporated municipality is to adopt an individual Conservation Element for the land within it's boundaries. Natural resources characteristically cross artificial political boundaries, and the identification, analysis, and planning for their utilization and conservation requires co-operation between governmental divisions and agencies. The County Conservation Element and those prepared by the municipalities and other governmental agencies should be mutually supportive.

Limitations. The intent of this Element is to identify the natural resources, issues, problems, and needs which must be considered if degradation of the environment through waste, mismanagement, or incompatible land use is to be avoided. All projects, public or private, are required to conform, however it is not the intent of this Element to impose any restriction on the use of any private land which would constitute a taking or damaging of property for public use which might require payment of just compensation for damages. If such a condition arises, the

provisions outlined in the OPEN SPACE ELEMENT, under "Limitations," shall apply. The natural resource areas, issues, and needs discussed are not intended to be all inclusive and may be expanded or modified when additional studies or information is made available.

Relationship to Other Elements. The Conservation, Open Space, Seismic Safety, Safety, Recreation, Noise, and the recommended Agricultural and Geothermal Elements form the Resource Management Program. Each element of the Resource Management Program is dependent upon, and reinforced by, all the other elements. Together they provide major policy and technical input to the Land-Use, Circulation, and Housing Elements of the General Plan. All elements of the General Plan are intended to be consistent and complimentary.

Relationship to Environmental Impact Reports. The adoption of this element in no way negates the requirements of environmental impact reports for public or private projects which may have a significant impact upon the environment. Although the project may be found to conform to the adopted general plan, this is not sufficient to determine the desirability or undesirability of a proposal. The environmental impact report permits analysis of the proposal based upon current local conditions and in recognition of changing technologies, goals, objectives, and policies. The Conservation Element, as well as other elements of the Resource Management Program will assist in the review of the EIR's. A proposed development must be evaluated to determine the extent to which it promotes the environmental values and standards expressed in the general plan elements.

Revision. Technological, legal, social, and economic innovation, as well as updated information and reordered priorities will necessitate periodic revision of the Conservation Element. The Board of Supervisors and the County Planning Commission shall review the Element and the Planning Division's recommended revisions at least annually. Section 65361 of the State Code prohibits the amendment of mandatory elements of the general plan from occuring more often than three times during any one calendar year.

AREAS OF STATEWIDE SIGNIFICANCE OR CRITICAL CONCERN

The California Office of Planning and Research has the responsibility of determining what areas are of statewide significance or critical concern and of adopting development guidelines to protect them. These guidelines include a list of incompatible uses and development practices which could destroy or significantly damage the quality of an identified area or resource. Where a proposed development falls within the geographic limits of an area of statewide significance, the responsible local government must consider the development guidelines before taking any action. Where proposed developments occur within areas of critical concern, the local government must determine if it is an incompatible use or development practices as identified in the development guidelines. If the proposal is determined not to be of this nature, local government is free to act, however notice of action taken must be submitted to the State through the State Clearing House. If the proposal is identified as an incompatible use or development practice, local government must notify the State and postpone action for 60 days. Alternative actions available to the State, as well as other policies and

programs are found in Environmental Goals and Policies Report of the State of California.

While the State has the authority and responsibility of determining classification of natural resources and resource areas, local government may petition for the deletion or addition of those which they feel are of statewide significance or critical concern. The County should examine it's natural resource and resource areas to determine which areas, if any, not identified in the initial State of California Environmental Goals and Policies Report may be of statewide significance or critical concern.

IMPLEMENTATION

The development and adoption of the Conservation Element will have little significance unless the goals, objectives, and policies which it contains are understood and accepted by the general public and implemented by their elected representatives. Decision-makers frequently decide issues which may have significant long-term effects upon the quality and availability of natural resources. The Conservation Element permits the resolution of conflicts involving the utilization, conservation, or possible loss of natural resources on the basis of adopted policies.

County codes and ordinances which affect land development need clarification and revision. In some instances existing codes and ordinances are unclear, inconsistent, obsolete, ineffective and assign little importance to environmental considerations as part of the development process.

All codes and ordinances which deal with the land development process must recognize and advance the goals and objectives specified in Elements of the General Plan and State Planning Law. Of particular note is A.B. 1301 which added Section 11549.5 to the California Business and Professions Code. This section requires that a city or county deny final or tentative subdivision maps if it makes any of several findings, including:

> " c. That the site is not physically suitable to the type of development proposed.
>
> d. That the site is not physically suitable for the proposed density of development."

Elements of the General Plan and areas designated by the State as being of statewide significance or critical concern help to define "suitable". Where appropriate, areas of significant natural resource value should be designated in the Open Space Element. Where this is not desirable, land use or development in areas of high resource value should be planned in a manner that will enhance the resource and assure continued availability. The County should not hesitate to reject proposals which do not consider and provide for the protection and enhancement of the natural environment.

GOALS AND OBJECTIVES

Although man is capable of significantly altering the natural environment, it is increasingly apparent that he cannot escape the long-term consequences of environmental misuse. The natural environment is a finely integrated system composed of fragile resources, each of which is essential to the maintenance of a natural equilibrium. If disrupted, wasted, or destroyed, they are often nonrenewable, and their absence may have a severe cumulative effect upon the functioning of natural processes. The quality of life is dependent upon the state of the environment; degradation of the resource base will be reflected in a reduced quality of life.

Conservation requires a detailed identification and rational analysis of natural resource characteristics so that effective programs may be devised for their maintenance and enhancement. The Resource Management Program (RMP) is to be based upon knowledge of the natural environment as derived from numerous studies and reports from Federal, State, and local agencies as well as interested citizens with special expertise. A considerable amount of work remains to be done in regard to developing adequate information on environmental factors from which land development regulations may be formulated. This program of data collection is a continuing process, and as information becomes better refined, more accurate determination of these intrinsic suitability of certain lands will be possible. This base will also provide valuable assistance in implementing the Environmental Quality Act of 1970, greatly enhancing the validity and quality of environmental impact reports.

There are some areas of concern that require direct, immediate attention if serious damage to natural resource values is to be avoided. These issues, as well as objectives pertaining to specific resource categories, are discussed in the subsequent functional sections of this Element. Their resolution will be evident when specific objectives are met, and will provide impetus to long-term goal realization. The development of effective management programs require the assessment of certain features of the resource being examined. Man places different values upon resources according to his own personal needs and desires. The relative value of each resource must be measured in terms of ecological and aesthetic significance, as well as it's economic value.

Many resources, for example water and air, transcend artifically imposed governmental boundaries. The County of Imperial must consult and co-operate with other governmental and quasi-governmental entities which have resource management responsibilities. The general goals and objectives of the Conservation Element are:

1. To enhance the quality of life through judicious conservation of the fragile resource base.

2. To recognize that the degradation of one natural resource will have a concomitant negative effect upon the total resource base, including water, vegetation, air, wildlife, soil, and minerals.

3. To identify the locations, quality, quantity, and unique characteristics of the area's natural resources, determine those that warrant special attention, and establish management programs that will provide for their enhacement and protection.

4. To provide for the economic supply of certain resources consistant with the need to ensure long-term resource availability and environmental integrity.

5. To develop a reliable, current, expanding natural resource data base for the purpose of enhancing both the planning and decision-making processes.

LAND-USE SUITABILITY

Imperial County has not experienced the rate or magnitude of growth characteristic of some of the coastal counties. This low rate of increase presents a valuable opportunity to provide efficient land-use guidance for areas best suited for development while conserving areas of significant natural resource value. This Element, coupled with the other elements of the General Plan, provides direction to the development and implementation of a land-use guidance system. Devices adopted to implement the General Plan, such as the zoning ordinance, are required to reflect the concerns and principles expressed in this and other elements if they are to meet the requirement for consistency.

Land-use guidance is not merely a process of co-ordination, but one of determining the basic suitabilities of the land and then balancing this with social, economic, and man-made considerations. The intrinsic suitability of land is determined by environmental constraints, however when attempting to arrive at the optimal use of the land, additional factors must be considered. Current land-use, ownership patterns, government regulations, transportation networks, and utility patterns also provide input to the evaluation process. Environmental factors impose physical restraints upon the suitability of a site for particular land uses. For example, limitations on allowable soil pressure may be severe. The construction of a multi-story, steel supported building would require significant structural engineering to overcome these restraints. The suitability of particular sites may be altered by adequate engineering, however the cost of such modification may make a given use economically infeasible.

The value placed upon such intangibles as plant and wildlife resources is necessarily subjective. It is difficult to measure these resources in economic terms, however the value of wildlife and wilderness areas for their aesthetic and recreational potential must be recognized.

The information contained in the Conservation Element is environmental background information, whose purpose is to establish the location of areas of environmental concern. Attention should be directed toward the adopted goals, objectives, and policies contained in this Element. The scarcity of reliable, accurate information regarding environmental resources and physical characteristics require that the maps depict only areas of resource interest and may not precisely define the geographical limits of specific resources or physical constraints.

CHAPTER II. WATER RESOURCES

ISSUES

1. Continuing deterioration in the quality of irrigation waters from the Colorado River.

2. Possibility of reduced quantity of irrigation water delivered after completion of the Central Arizona Project.

3. Plant and wildlife values versus flood control and floodplain management along natural drainage ways.

4. Deterioration of water quality resulting from the disposal of untreated or minimally treated sewage effluent from Mexicali, and County municipalities.

5. Increased salinity of New and Alamo Rivers resulting from high salinity agricultural return water used for leaching purposes.

6. Areas of potential flooding, notably wash areas, are not adequately identified and may represent a serious threat to public safety.

7. Increasing salinity and rising level of the Salton Sea.

8. The effect upon Imperial County of the United States-Mexico agreement to reduce the salinity of irrigation water delivered to Mexico is unclear.

OBJECTIVES

1. Aid in the protection and enhancement of limited water resources so as to provide for indefinite use and maximum enjoyment.

2. Encourage and provide for the management and wise use of water resources for contact and non-contact recreation, groundwater recharge, hydroelectric energy production, and wildlife habitat as well as for domestic and irrigation use.

3. Provide for the regulation of land-uses so as to economize on water consumption and to minimize negative effects upon water resources.

RESOURCES DEMAND

Southern California is highly dependent upon imported water supplies, nowhere is this more evident than in the interior desert regions. Only by the impor-

tation or diversion of vast quantities of water has California been able to sustain its growing population. Imported water has removed the natural limitations on population imposed by scarce local supplies and created a critical dependence upon outside sources of water. Without these, only a minute fraction of the present population could be supported by local sources. Urban demand for water is determined in part by population and the amount of industrial and commercial development. Urban demand in the Colorado Desert Area (Imperial, eastern San Diego, Riverside and a portion of San Bernardino County) is expected to increase from 60 thousand acre feet annually (1967) to 110 thousand acre feet by 1990.

Water resources are extremely limited in Imperial County, and local sources are generally of inferior quality for most purposes. The effectiveness of regional, state, and inter-state water quality control plans will be clearly reflected in the future quality of Colorado River water. In 1967 the California Legislature created the State Water Resources Control Board to deal with questions of water rights and quality. This Board controls nine regional boards, one of which is the California Regional Water Quality Control Board, Colorado River Basin Region, that includes Imperial County. This Board formulates water quality control plans for the region, establishes and enforces waste disposal regulations, and implements State Board policies. It is also responsible for long-range resource planning, and is required to examine all facets of water resources.

Water resources serve a range of functions in addition to domestic and irrigation use. The recreational use, scenic beauty, and wildlife habitat which these resources provide are especially important in the arid desert.

Irrigated agriculture, the largest consumer of water supplies in the Colorado Desert Region, accounted for 3.90 million acre feet (MAF) in 1967 and is projected to increase to 3.93 MAF by 1990. While the magnitude of this increase is less than that projected for the urban sector, irrigated agriculture will still account for the major portion of total applied water demand in 1990. This minimal increase will result from changes in cropping patterns and more efficient irrigation practices. The dependence of Imperial County on adequate supplies of diverted water is highly visible. Valley soils exhibit high inherent fertility; the absence of local water, however, prevented its utilization. The introduction of Colorado River water into the Valley has created one of the most productive agricultural regions in California. Lacking suitable quality groundwater, Imperial County must rely on the Colorado River as the primary source of domestic, urban, and irrigation water. Irrigated agriculture in Imperial County is greatly influenced by development in the upper Colorado River Basin. Increased farming in those areas may result in greater salinity of downstream water, an already critical problem. The deteriorating quality of the River, coupled with a possible reduction in quantity, pose serious problems for irrigated agriculture.

While Imperial County or other local agencies can do little to improve the quality of delivered water, local policies regarding land-use and utilization have a significant effect upon in-county waters. The role of the County in the protection and enhancement of water quality is to guide the location, type, and density of development. While state boards may define the maximum constituent level acceptable for discharge to various waters, local land-use decisions will have a significant effect upon the

location, quantity, and type of waste discharged. Low precipitation and permeable soils minimize the effectiveness of watershed management in increasing available water supply, as only limited run-off contributes to surface stream flow. While a small amount of run-off may reach the Salton Sea or other major surface waters (including canals), most is absorbed into the desert soils. The goal of watershed management in the local context then is not basically to protect surface water from sedimentation or to increase usable run-off, but rather to reduce the severe gully erosion characteristic of some areas. Land-use decisions should consider the protection and enhancement of the limited water resources available.

SURFACE WATER

Colorado River. The Colorado River flows along the eastern border of Imperial County and provides domestic and irrigation water to the entire valley. Snowmelt and storm run-off in the Upper Colorado River Basin historically resulted in destructive floods in the eastern county and Yuma, Arizona areas. Perhaps the most significant from the local standpoint was the 1904 flood which created the present Salton Sea after breaking through temporary diversion works near Andrade Circle. The largest flood of record had a peak discharge estimated at 250,000 cfs at Yuma on January 22, 1916. Construction of Hoover, Parker, and Davis dams has essentially eliminated the danger of extreme floods reaching lower basin areas. Although some possibility of flooding remains, notably from lower basin tributaries and storm run-off, the magnitude, frequency, and destructive potential has been significantly reduced.

Most of Imperial County adjacent to the Colorado River has been designated for either recreational use or wildlife refuge (See the Open Space Element). Its backwater areas and vegetation provide valuable riverine habitat and scenery. The Colorado River is one of the primary recreation attractions of the Southwest, and ever increasing recreational pressure on this resource may be expected. While the Colorado River Basin Project Act of 1968 limited California's priority share of Colorado River water to 4.4 million acre feet per year, California agencies contract with the Department of Interior for 5.362 maf per year. It is expected that completion of the Central Arizona Project will result in a reduction in the quantity of water delivered to California. Imperial Valley irrigation districts have priority rights to deliveries, however some reduction in the total annual water delivered may occur. The Imperial, Palo Verde, and Coachella Irrigation Districts will lose rights to 300,000 acre/feet of second priority water (Water for California, December 1970). Closely associated with the possibility of reduced quantities is the continuing problem of quality. Water quality has declined steadily over the past years due to increasing development by upstream users. The measure of this deterioration is higher concentrations of dissolved mineral salts. During the period 1963 to 1967, total dissolved solids (TDS) measured at Imperial Dam averaged 850 ppm. Table 1 shows the constituent concentrations and characteristic of Colorado River water upon arrival at Imperial Dam in 1969. A study by the Regional Water Quality Control Board indicated that average salinity at Imperial Dam in the year 2000 will approach 1340 ppm.

TABLE I

COLORADO RIVER WATER QUALITY

Constituent or Characteristic	Units	Imperial Dam	
		Maximum	Average
Temperature	^{o}F	82.0	75.0
pH	Scale	8.2	8.1
Conductivity	Micromhos	1322.0	1286.0
Calcium	mg/l	95.0	92.0
Magnesium	mg/l	34.0	33.0
Sodium	mg/l	152.0	141.0
Potassium	mg/l	5.0	5.0
Carbonate	mg/l	0.0	0.0
Bicarbonate	mg/l	171.0	170.0
Sulphate	mg/l	353.0	344.0
Chloride	mg/l	136.0	125.0
Nitrate	mg/l	2.5	2.1
Flouride	mg/l	.7	.6
Boron	mg/l	.19	.18
T D S	mg/l	880.0	862.0
Dissolved Oxygen	mg/l	9.4	8.3

California Regional Water Quality Control Board- Colorado River Basin. June, 1971

The results of this increased salinity may have a significant effect upon the type of crops grown and total productivity. High salinity increases the amount of water required to irrigate a given unit of land. This increase in demand results from the necessity to apply large amounts of leaching water to maintain a favorable salt balance in the soil. Increased salinity, coupled with the possibility of a reduction in the total amount of water delivered, may result in reduced productivity, introduction of more salt-tolerant crops, or even the removal of some lands from cultivation.

Methods by which the increasing salinity may be mitigated are currently being studied by agencies responsible for water qualtiy. These include water salvage projects, reduction of water loss through phreatophyte control, and augmentation of river water with low-saline water. Should desalinization of geothermal brines prove practical, introduction of this water to the river may significantly reduce overall salinity.

There are three dams along the Imperial County stretch of the Colorado River, including Imperial, Laguna, and Senator Wash Dams. These are used primarily to regulate the delivery of irrigation water and do not afford significant flood protection. Imperial Dam is in the location of the desilting works and also the point of diversion to the All-American Canal. This canal flows at a rate of 15,155 cfs and provides water to other major canals serving Imperial and Riverside Counties. The main branch of the All-American Canal is the 123.5 mile Coachella Canal. This canal provides water to the Coachella Irrigation District and serves the Coachella Valley, Desert Shores, Salton Sea Beach, and Salton City. Imperial Irrigation District controls the first 47.5 miles of this canal and from it provides irrigation water to the Niland area. Both the All-American and Coachella Canals lose

significant amounts of water to evaporation and seepage. To reduce the latter, the Bureau of Reclamation has proposed lining of the unlined portion of these canals. It estimates that lining would salvage 78,000 acre feet per year from the All-American and 160,000 acre feet per year from the Coachella. Seepage from these canals support vegetation which provides habitat to a variety of wildlife. Lining would eliminate the vegetation and destroy existing wildlife habitat unless some mitigating measures are included.

New River and Alamo River The New and Alamo Rivers originally served as overflow channels for the Colorado River. With the upstream regulation of most of the flood potential of the Colorado River, these rivers now serve primarily to collect and transport irrigation drainage water in the Imperial and Mexicali Valleys. The State Water Resources Control Board has designated this as the primary beneficial use of these rivers, and determined that water quality is not unreasonably affected. The objective is to protect the quality of "source water" (drainage) "from degradation by unreasonable impairment (1) by pesticidal wastes from any source, and (2) by other industrial wastes, or by sewage." (Regional Water Quality Control Board, December 1972). "Industrial wastes" does not include drainage wastes from irrigated agriculture. Specific standards relevant to controlling the constituents and characteristics of waste discharges are established by the Board consistent with the above objective. The use of these rivers for the transportation and disposal of irrigation drainage is reflected in the amount of dissolved solids which they carry. During the period 1943 to 1971 the average annual flow of the Alamo River near Niland, approximated 619,000 acre feet and had total dissolved solids (TDS) equaling 2,500 mg/l. During the same period, the New River near Westmorland, carried 445,000 acre feet with a TDS of 3,500 mg/l. Both of these rivers have high bacteriological counts. A large portion of the

coliform organisms in the New River result from disposal of inadequately treated sewage. Irrigation drainage is also a significant source of these organisms in the New River and probably the major source in the Alamo River.

Minor Surface Streams. Due in part to low precipitation and run-off characteristics, flowing surface streams are scarce in the lower Colorado Desert. Some small streams which exist in the Anza-Borrego and San Felipe areas flow intermittently. San Felipe Creek is one of the few flowing desert steams and provides a unique habitat area. The necessity of providing for the protection of San Felipe Creek has been recognized in the Land Use Plan and the Open Space Element.

Salton Sea. The Salton Sea was established in 1904 as a permanent body of water when the flooding Colorado River broke through temporary irrigation control devices and flowed unrestricted for over two years. After the river was controlled in June 1907, the sea was maintained by irrigation wastewater and natural drainage. The State Water Resources Control Board has concluded that "the primary purpose of the Salton Sea is to receive natural and agricultural drainage and seepage waters (Regional Water Quality Control Board, December 1972)." The Board has also established restrictions upon the discharge of sewage and waste material to the Sea, and the discharge of sewage to the New or Alamo River that has not had minimum treatment to remove settleable materials. The Regional Water Quality Control Board has the authority to require compliance to assure that minimum water quality standards are maintained.

Inflow to the Salton Sea consists of irrigation return, domestic waste, seepage, run-off and groundwater inflow. Sources include the Alamo River (619,000 acre feet/yr ±), the New River (445,000 acre feet/yr ±), White-

water River (100,000 acre feet/yr ±), Salt Creek, San Felipe Creek, and about 30 drains in Imperial County and 18 ditches from Coachella Valley. Approximately 90% of the inflow is from Imperial County. Impermeable soils generally restrict groundwater inflow except for the Coachella Valley and San Felipe Creek area. Total groundwater inflow is less that 50,000 acre feet per year of which 30,000 acre feet is from the Coachella Valley, 10,000 acre feet from San Felipe Creek, and less than 2,000 acre feet from Imperial Valley.

During the 1960's the Salton Sea developed into an important recreational and wildlife habitat area. Increasing salinity, lower water quality, and a rise in the level of the Sea have created problems which jeopardize the continuation of these functions. During the initial inflow in 1904, the water was relatively pure, having only about 300 ppm TDS. By mid-1907 the Sea was decidedly saline with TDS at 3,600 ppm. It has since reached higher concentrations, and normally ranges between 32,000 and 43,000 ppm. The Sea presently has six million acre feet of water with TDS of 38,000 ppm, slightly higher than ocean water.

Increased salinity is attributable to several factors, including the diffusion of sub-bottom salt deposits, high salinity irrigation wastewaters, and the absence of outflow. The Sea originally became highly saline as a result of the diffusion of sub-bottom salt deposits left in previous periods of Colorado River flooding. It is estimated that of the approximately 300 million tons of salt presently in the Sea, about 113 million tons are from redesolved deposits. It is expected that this natural diffusion will continue, however at a decreasing rate. Irrigation source waters are becoming increasingly saline, and as Colorado River water continues to decline in quality, salt deposited in the Sea from this source may be expected to rise. One estimate places the amount of salt that is added to the Sea each year at

5.6 million tons. Evaporation from the Sea accounts for about 69" per year, or 1.34 million acre feet, and further concentrates the remaining saline solution.

There have been several procedures proposed which would aid in checking the salinity problem. Most involve the pumping of water and minerals out of the Sea, perhaps to nearby dry lakebeds; the use of dikes to limit the surface area of the Sea and thereby reduce evaporation; or the use of a diked impoundment area to remove and concentrate the saline Sea water. The last proposal appears to be the one most likely to be implemented. Proponents include the U.S. Department of Interior and the California Resource Agency. The water level inside the impoundment will be below that of the Sea so that it may provide much needed outflow of saline seawater. Salt could accumulate in the impoundment 50-100 years before removal would be required. This procedure would establish a balance between evaporation, inflow of less saline irrigation water, and outflow into the diked area. Valuable marshland habitat for waterfowl may also result from the breakwater. The cost of this impoundment has been recently estimated to range between 38 and 58 million dollars, depending upon whether dredged material is used or not.

The nutrient content of the Sea has also increased to undesirable levels. Introduction of minimally treated or untreated sewage far upstream has seriously affected downstream water quality. This is compounded by the addition of irrigation wastewater containing fertilizer and pesticide residues. This situation has seriously damaged recreational and sporting operations on the Sea and visitor-use has noticeably declined. Adoption and implementation of proposed State Water Resources Control Board regulations may help to alleviate this problem. The elimination of the discharge of untreated sewage

into the New River by Mexicali, Mexico would have a noticeable beneficial effect upon the water quality.

While the primary purpose of the Salton Sea as a recipient of irrigation waste water is recognized, the use of the sea as a valuable recreational and wildlife resource is extremely important to Imperial County. Protection of existing investments and the encouragement of future development in the Salton Sea area are dependent upon adequate solutions to the problems of increasing salinity and nutrient levels. No single agency has the authority to initiate or implement the program needed to solve these issues. The County should examine its role in this program and determine the amount and type of support it is capable of providing.

GROUNDWATER

Groundwater is important in some areas of the Southwest for domestic, industrial, and agricultural purposes. Uncontrolled growth in water deficient areas has resulted in groundwater "mining", the removal of subsurface water in excess of the amount returned by natural recharge. This results in a lowering of the groundwater table, and may have serious effects upon vegetation, micro-climate, wildlife habitat, and surface stability of the area. Large scale irrigation in the Central portion of the County creates an aquifer condition which practically precludes dewatering of shallow aquifers by pumping from wells. The low transmissivity of these aquifers and the availability of large quantities of water from shallow drains and canals would eventually prevent additonal drawdown. Proper control of soil salinity requires application of large quantities of water in excess of that required for crop use. In Imperial Valley this accounts for more than one million acre feet per year. As this surface water percolates

to the groundwater, it too becomes highly saline and is essentially unrecoverable.

The quantity, geographic extent, and quality of groundwater is closely related to the geologic environment, for instance the type, character, and thickness of saturated sediments. Imperial Valley is characterized by extremely deep deposits of sedimentary soils which approach a depth of 21,000 feet. These recent alluvial or sedimentary soils have excellent storage characteristics and USGS has estimated that 1.1 billion acre feet of usable and recoverable water exists in Imperial Valley. This includes geothermal waters which are deep, very hot, and highly saline. The potential of desalinization of geothermal water is discussed in the Geothermal Resource section of this element.

The amount of recoverable groundwater is dependent in part upon the porosity of the sediments and density of the water. With the exception of the mouth of San Felipe Creek, much of the alluvium in Imperial Valley is fine grained and does not readily yield water to wells. While the Central part of the Valley does contain some flowing wells, conditions for the development of substantial quantities of usable groundwater are unfavorable. Test wells at Imperial and east of Calexico indicated low transmissivity and specific capacities, approximately 1 gallon/minute per foot of drawdown. Wells having a specific capacity of less than 10 are generally considered of marginal value for irrigation use.

The structural development of Imperial Valley has greatly influenced the quality of groundwater in the region. During years of periodic flooding extensive areas of salt were deposited and subsequently covered by sedimentation. As subsurface water flows through these trapped deposits it becomes increasingly saline. The groundwater in most of the Valley is sodium chloride

in character and often contains high concentrations of boron and fluoride. It is considerably more saline toward the Salton Sea, with the exception of the northwest area where subsurface recharge by the Whitewater River minimizes salinity. Most groundwater contains minerals in excess of USPHS Drinking Water Standards and is Class 3 irrigation water, conditions which indicate it's unsuitability for domestic or irrigation use. Irrigated agriculture is based upon the availability of large quantities of cheap water. High TDS, which averages 1500 mg/l, and inexpensive Colorado River water has precluded any measurable use of groundwater in the County.

Historically, groundwater recharge occurred primarily at the Colorado River or the base of the mountains which surround the basin. Total groundwater recharge from the Colorado River under natural conditions was approximately 17,000 acre feet per year. This figure does not include the large quantities of recharge which are today contributed by irrigation canals and irrigated lands. A small amount is contributed by local sources, though under present rainfall and run-off conditions this probably accounts for about half of the long term average or about 1500 acre feet per year. Discharge of groundwater in the past was to evapotranspiration from vegetation on shallow water tables or to evaporation from groundwater fed shallow lakes. The introduction of large scale irrigation has altered these discharge relationships. Today, most groundwater discharge is to the land surface, river channels, or the irrigation drainage tile network.

Excluding high temperature geothermal waters, groundwater in the Valley ranges from 70° to 180° Farenheit.

Detailed knowledge of the aquifer system, the physical properties of the water, and the state of technological ability are necessary to determine the amount of water that is economically recoverable. The State Water Resources

Control Board has delineated several "hydrologic units" in Imperial County and are shown on the Water Resources Map. Table 1 provides a brief description of the quality of groundwater in each hydrologic unit. While groundwater is presently unsuitable for most beneficial uses, future water requirements may make extraction and desalinization economically feasible. Care should be taken to assure that subsurface waters are not imparied further by recharge of geothermal brine or polluted by irrigation, mining, or industrial waste or domestic sewage. Effective management of groundwater sources is limited by the lack of knowledge concerning aquifer system boundaries and characteristics.

TABLE 2

IMPERIAL COUNTY GROUNDWATER

HYDROLOGIC UNIT	SUBUNIT	DESCRIPTION	WATER QUALITY INDICATORS
ANZA-BORREGO	OCOTILLO-SAN FELIPE	Broad, sloping desert floor alluvium along which San Felipe Creek drains adjoining ranges and discharges northeastward to the Salton Sea.	
WEST SALTON SEA		Broad plain of recent and older sediments which slope upward in a westerly direction from the southwest shoreline of Salton Sea. Travertine Rock at northerly corner of Unit is considered to prevent Coachella Valley groundwater from entering the Unit. Soil permeability moderate to high in valley floor, more moderate in upper slope areas. There are no perennial streams and run-off normally infiltrates into stream alluvium at higher elevations. Brakish water underlies most of Unit.	TDS 2241-16600 mg/l Sulfate 1-1810 mg/l Hardness 52-1924 mg/l Fluoride 0-6.2 mg/l Boron 0-22.3 mg/l Chloride 700-8220 mg/l Sodium 58-96%
IMPERIAL		Mostly broad Imperial Valley with Chocolate Mountains and sand hills along northeastern boundary and coast range mountains in most westerly corner.	
	IMPERIAL	Practically all of Unit except for approximately 150 miles in most southwesterly corner. Rainfall averages 3" a year. Quickly drained to Salton Sea and cannot contribute appreciably to groundwater replinishment because most of the soil is very tight. Analysis indicates that water quality is not suitable for domestic, irrigation, or comparable beneficial uses.	TDS 818-15120 mg/l Sulfate 5-4502 mg/l Hardness 305-2373 mg/l Fluoride 0.1-3.5 mg/l Boron .08-6.6 mg/l Chloride 129-5337 mg/l Sodium 45-83
	COYOTE WELLS	Approximately 150 square miles in most southwesterly corner of Unit. Two wells sampled in 1964 indicate excellent quality water for all beneficial uses.	TDS 367-409 mg/l Sulfate 40-75 mg/l Hardness 92-271 mg/l Fluoride .5-.7 mg/l Boron .08-.2 mg/l Chloride 86-87 mg/l Sodium 29-64%
DAVIES		Approximately 20 square miles near the southwest corner of the basin near border with Mexico. Nearly all impermeable rock. No water quality or quantity data are available.	
AMOS-OGILBY		Southeast corner of the Basin, between the sand hills and Chocolate Mountains. Typically low desert. Groundwater from deeper aquifers near center of Valley has a high TDS content and is inferior for irrigation, domestic, or municipal purposes. Water of suitable quality for all uses occurs in southeastern portion of Valley.	TDS 1185-1900 mg/l Sulfate 244-275 mg/l Hardness 145-339 mg/l Fluoride 1.8-3.4 mg/l Boron .96-.98 mg/l Chloride 430-897 mg/l Sodium 78-84%
CLARK		Approximately 30% of Unit's surface consists of permeable sediments; the remainder is essentially impermeable rock. Unit drains internally to Clark Dry Lake. Water is unsuitable for domestic and irrigation use.	TDS 560-4677 mg/l Sulfate 170-2049 mg/l Hardness 58-1590 mg/l Fluoride .9-2.5 mg/l Boron 0-.12 mg/l Chloride 16-765 mg/l Sodium 51-84%
COLORADO		All California lands draining to Colorado River from Parker Dam to Imperial Dam. Recent groundwater quality data is very meager or unavailable.	
	PALO VERDE	Formed by ridgelines of Big Maria Mountains on north, McCoy and Mule Mountains on west, Palo Verde Mountains on south. Water is generally unsuitable for domestic and certain agricultural uses.	TDS 934-1418 mg/l
	ARROYO SECO	Extends from Palo Verde Mountains southward along Colorado River to Imperial Dam. Groundwater in this Valley ranges widely in composition and mineral concentration. Samples from two wells in northwestern area showed high mineralization. Well in central part of Subunit has low concentration and TDS, and were generally suitable for domestic and irrigation use.	
YUMA		Most southeasterly portion of California. Bounded on south and southeast by portions of present and former Colorado River channels, northeast by Picacho Mountains, on west by Cargo Muchacho and alluvial summits. Groundwater benefits greatly from seepage of water from the All-American Canal which supplies large quantities of water to underlying aquifers. Ranges widely in character and mineral concentrations. Samples in mid-1950s indicated.	TDS 616-1677 mg/l

California Regional Water Quality Control Board, Colorado River Basin Region, June 1971.

IRRIGATION WATERS

Interest in the irrigation of Valley lands began over one-hundred and twenty years ago. Several attempts to acquire federal lands for irrigation failed in Congress and first attempts to provide irrigation water from the Colorado River failed because of economic problems in 1892. In 1900 the California Development Company succeeded in providing irrigation water from the Alamo River. By 1904 there were 75,000 acres of irrigated land and 700 miles of canals. The position of Imperial County as a leading producer of agricultural products provides ample proof of the success of irrigated agriculture.

Irrigated agriculture requires adequate quantities of suitable quality water. An average of 3 acre feet of water for each acre of land is normally required, while 7-8 acre feet may be needed for areas with high leaching requirements. If agricultural production is forced to move from prime lands to those of lower quality, additonal quantities of water may be required just to maintain current production.

Irrigation water enters the irrigation delivery system at Imperial Dam. Measures taken of water at this Dam indicate the deteriorating quality of irrigation water. The University of California at Davis has established three classes of irrigation water:

Class 1. - Excellent to Good. Regarded as safe and suitable for most plants under any condition of soil or climate.

Class 2. - Good to Injurious. Regarded as possibly harmful for certain crops under certain conditions of soil or climate, particularly in the higher range of this class.

Class 3. - Injurious to Unsatisfactory. Regarded as probably harmful to most crops and unsatisfactory for all but the most tolerant.

The criteria used to place irrigation waters into these classes are contained in Table 3. Colorado River water is presently sodium - calcium sulfate in character, very hard, and Class 2 for irrigation.

TABLE 3

CRITERIA FOR IRRIGATION WATERS

Factors	Class 1 - Excellent to good	Class 2 - Good to Injurious	Class 3 - Injurious to Unsatisfactory
Specific electrical conductance, $EC \times 10^6$ at 25° C	Less than 1,000	1,000 - 3,000	More than 3,000
Boron, mg/l	Less than 0.5	0.5 - 2.0	More than 2.0
Chloride, mg/l	Less than 175	175 - 350	More than 350
Percent sodium	Less than 60	60 - 75	More than 75

(Department of Water Resources, December 1970)

The efficiency of irrigated agriculture depends upon crop type, soil characteristics, methods of conveyance and application, and leaching requirements. Sprinkler application is used extensively in other areas and may offer significant water savings to Imperial County. Seepage and evaporation from conveyance channels is significant, although the Imperial Irrigation District has a continuing program to reduce these losses by concrete lining of laterals. Approximately one-third of these laterals are presently lined and the District plans to line 40-50 miles per year. The Imperial Irrigation District is also attempting to reduce seepage from major canals by installing buried drains parallel to the East Highline Canal to intercept these waters. This water is then drained by gravity to collecting wells and pumped back into the canal system. The Imperial Irrigation District does not foresee any major expansion of canals or laterals over the next 20 years unless agricultural production is forced to move to new areas.

CONSERVATION

Adequate quantities of quality water are essential to retain and enhance agricultural production and the overall quality of life. To ensure the availability of this supply, appropriate conservation measures are necessary. Large scale structural alternatives such as the inter-basin transfer of water is long-range, very expensive, and often unwarranted. Enormous quantities of water may be saved each year through effective management practices alone. Desalinization of Salton Sea water or geothermal brine may be feasible, however both involve substantial investment. The potential for desalinization of geothermal water is discussed in the Geothermal Resource section of this element.

The initial quality of Colorado River water generally precludes reclamation or reuse without demineralization or substantial blending with better quality water. Leaching practices remove salt from Valley soils and may further increase the salinity of irrigation waste waters.

Irrigated agriculture is the primary consumer of water in the Valley and thus may provide the most substantial savings. A voluntary program to reduce water losses by lining conveyance and distribution systems is currently being implemented by the Imperial Irrigation District. Improved irrigation practices would provide additional savings. Large amounts of water are lost or wasted by inefficient application methods which permit excessive run-off or percolation. The Imperial Irrigation District presently requires that no irrigator permit more than 10% of the delivered water to run off the land as waste. This requires more precise methods of measuring and ordering water. More uniform application of water, for instance by sprinkler or drip irrigation, provides better distribution and control of water. Research regarding the precise control of timing and amount of water applied considering infiltration capabilities will also assist in water conservation. Imperial Irrigation District is considering the construction of ten small reservoirs to increase the efficiency of water delivery. These will contain approximately 20-30 acre feet of water and cost between 4 and 5 million dollars. Evaporation suppression is very important in reservoirs located in extremely hot, low humidity areas such as Imperial County.

The Bureau of Reclamation has developed the Comprehensive River Management Plan for the Lower Colorado River-Yuma Division. This plan is to provide stabilization and control of the River from Laguna Dam to a point two miles above Morales Dam. A deeper central channel would be dredged to restore

the capacity of the low-flow channel. Water salvage from this plan would result from reduced surface evaporation and phreatophyte control. Phreatophytes are plants which obtain their water supply through deep root systems which penetrate the water table. These plants lose considerable amounts of water through evapotranspiration. Water salvage may account for almost 30,000 acre feet a year if the plan is completed. The project is approximately one-third complete and is presently delayed by environmental considerations. The desirability of this type of water salvage program depends in a large part upon the degree of impact it would have upon recreational use, scenic attractiveness and wildlife habitat. This plan does have significant impact upon these values and is discussed in the Biological Resource Section of this element.

Water meters may reduce domestic consumption by requiring the consumer to pay for the amount of water that is used. Flat rates utilized by some municipalities tend to discourage economical use and conservation of water resources. While domestic consumption does not account for an appreciable portion of the total quantity of delivered water, it's conservation is important. As population increases, uneconomical use of water may require expansion of water treatment facilities and involve significant capital expenditures. Such expansion may be unnecessary where treated water used more conservatively.

POLICIES

1. Evaluate all development proposals to determine excessive, unforeseen loads on existing water and waste management facilities.

2. Support programs and policies of the State Water Resources Control Board, Regional Water Quality Control Board, or other agencies which promote the wise and efficient use of water resources. Of particular importance are the State Water Resources Control Board's regulations pertaining to water quality control and land development.

3. Encourage municipalities to consider the initiation of water metering programs to promote more economical use of domestic water.

4. Encourage the adoption of improved methods of irrigation which will provide more efficient utilization of water.

5. Identify and evaluate watershed areas which exhibit site deterioration from excessive erosion. Development or intensive recreational use of these areas should be prohibited.

6. Information regarding potential flooding, notably in wash areas, is adequate. Dangerous wash areas must be identified and development or temporary habitation prohibited.

7. The recreation, scenic, and wildlife values of water resources are very important in Imperial County. The effect of proposed uses upon these values must be carefully examined.

RIVERSIDE COUNTY
SAN DIEGO COUNTY
IMPERIAL COUNTY
ARIZONA
MEXICO
WEST SALTON
ANZA - BORREGO
Ocotillo - San Felipe Sub-unit
CLARK
Coyote Wells Sub-unit
DAVIES
IMPERIAL
Imperial Sub-unit
COLORADO
Palo Verde Sub-unit
Arroyo Seco Sub-unit
AMOS OGILBY
YUMA
LEGEND
HYDROLOGIC UNIT BOUNDARIES
SUB-UNIT BOUNDARIES
ACCEPTABLE GROUNDWATER POTENTIAL
SURFACE WATER
MAJOR CONVEYANCE CHANNEL
URBANIZED AREAS
WATER RESOURCES
SCALE IN MILES

GEOLOGIC FACTORS

Knowledge of the geologic structure of the region is important in determining hazardous areas as well as areas of environmental concern such as aquifer recharge zones and potential mineral resources. The suitability of an area for a particular land use is in part an expression of geologic factors. Depth to bedrock and adequate bearing capacity are primary determinants of urban form.

Geologic description are of limited value unless there is an understanding of the characteristics of geologic structures. Knowledge of the characteristics of water deposited sediments is particularly important in the local setting as the major portion of the County is of this type. The generally unstable nature of alluvial material, such as its susceptiablility to erosion and subsidence, is of primary concern in evaluating various areas. The type of geologic base material also affects the inherent fertility of soils derived from it; alluvial soils are often fertile. On the other hand these deposits are not highly productive of valuable metals; these are found mostly in the igneous or metamorphic mountain areas.

There are basically four major classes of geologic units in Imperial County:

1. Igneous and Metamorphic rocks of the surrounding mountains.
2. Tertiary Age sedimentary rocks of marine and non-marine origin.
3. Quaternary Age lake-bed deposits of silt, clay, and evaporites.
4. Quaternary Age alluvium consisting of gravel, sand, silt, and clay.

(Geological Survey Circular 649, 1972)

The Salton Sea Trough is characterized by Cenozoic deposits several thousand feet deep. The origin of this sediment was primarly the Colorado

River, although the adjacent mountain areas have made a limited contribution. The maximum depth of these deposits is approximately 21,000 feet, thus there is essentially no bedrock available in most of the County. The irrigated area is roughly coterminous with the shoreline of ancient Lake Coahuila and is composed of Quaternary (last 12 million years) lake deposits. Alluvium and Pleistocene non-marine sediments cover extensive portions of the County, particularly at the base of the mountains. Fingers of fanglomerates, alluvial sands and silts, and lacustrine silts and clays are complexly interwoven in these areas. Pre-Cenozoic crystalline rocks are found in the mountains that border the trough and presumably underlie the Cenozoic deposited sediments. The mountains are primarily extrusions of Tertiary volcanic, Precambrian igneous and metamorphic rock complexes, and Mesozoic granitic rocks. The mountains exhibit extensive right-lateral, northwest-trending faulting. Wind blown sands are found throughout the region. There is also some evidence of geologically recent volcanic activity in the Obsidian Buttes area, and hot springs, mud pots and mud-volcanoes are found near the southeast portion of the Salton Sea.

CHAPTER IV. LAND RESOURCES - MINERALS

ISSUES

1. Loss of valuable mineral resources resulting from conflicting land uses upon or adjacent to potential extraction sites.

2. Mineral extraction, particularly open quarry operations, may have a significant effect upon the environmental and scenic quality of the desert.

3. A noticeable shortage of quality gravel resources suitable for roadbuilding and other construction purposes within the County.

4. Loss of archeologic and paleantologic sites resulting from extraction of mineral resources.

OBJECTIVES

1. Encourage the maximum utilization of available mineral resources consistent with the protection of the natural environment.

2. Protect areas of significant mineral resource value, including available sand and gravel sources, from unplanned urbanization.

MINERAL RESOURCE POTENTIAL

The California desert yielded over 160 million dollars in raw minerals in 1970. The U. S. Bureau of Mines projects this figure to approach three hundred million dollars by 1980. (Cry California, Winter 1972-73). Minerals extracted in Imperial County in 1970, in order of value, were gypsum, sand and gravel, lime, clay, and stone. While these are predominately low value construction materials, significant deposits of other minerals do exist in the igneous or metamorphic mountain areas of the County. The location of these minerals are shown on the Mineral Resource Map and are described briefly in Table I.

TABLE 1

IMPERIAL COUNTY MINERAL RESOURCES

RESOURCE	SYMBOL	GENERAL FEATURES
Barite	B	Small deposits in Palo Verde area present limited potential. Large tonnage of barite rock is not visable at the surface.
Calcium Chloride	⊞	Potentially large source in geothermal brine in the vicinity of the Salton Sea.
Clay (Bentonite)	▽	Most reactive of clays, useful as filtration and clarification aid. Deposits near Brawley.
Copper	●	Deposits appear as veins and replacement deposits of complex lead-zinc-copper ores in faulted areas. Ogilby district has limited deposits.
Feldspar	◸	Red Desert, Elliot Deposits, Superstition Mountains, Cargo Muchacho Mountains.
Gold	●	Gold discovered between 1775 and 1780 on the Lower Colorado, Picacho and Cargo Muchacho districts. Cargo Muchacho district one of most productive areas in Mohave Desert. Picacho and Potholes also considered gold-bearing areas.
Gypsum-anhydrite	▱	Most extensive gypsum deposits in California. Primarily western part of County, northwest side of Fish Creek Mountains. Generally white to light grey, massive, fine to medium grained rock gypsum. Beds 5 to 100 feet thick. Mixed with strings of anhydrite that gradually increase in thickness and quantity until entire mass is anhydritic. Original extent of deposit unknown, now isolated to erosional remnants scattered over an area about 4 miles long and 2½ miles wide. Additional deposits exist on the eastern side of the Fish Creek Mountains and in the Coyote Mountains.
Kyanite	△	One of two deposits sufficient to be defined as resources in California is located at Ogilby. Ceased production in 1945 due to market conditions.
Limestone	L	Coyote Mountains prossess very large resources of blue-grey to white, medium to coarse-crystalline limestone and some dolomite. Overlapping this crystalline core are discontinuous masses of shell-bearing limestone up to 50' thick. These are of two types, both of which could serve as a supplemental sources of cement grade limestone if the larger deposits of crystalline limestone are brought into production. Large bodies suitable for cement are present, notably in the vicinity of Carrizo Mountain.
Lithium	⊕	Possible extraction of lithium oxide from Geothermal wells in Salton Sea area. Accounts for approximately .065% of the brine solution.
Manganese	◺	Generally large, low grade deposits not suitable for extraction. The Whedon (Pioneer) mine once produced over 15,000 tons, but all manganese production in California ceased by 1959. Could produce at premium prices but extent of deposit unknown.
Mica	⊠	Most important deposit in California is the Micatalc mine which has produced several thousand tons of flake mica from mica schist. Located in lower southeast portion of County.
Potash	K	Generally potassium oxide and other salts. Potential source is the geothermal brine from the Salton Sea Area. Brine consists of 25,000 ppm potassium.
Pumice	P	Pumice for aggregate uses mined from tuff layers associated with sands and gravels near southeast Salton Sea area.
Silver	●	The paymaster Mine (toward Palo Verde area) and the Cargo Muchacho Mountains produce silver as a by-product of gold mining operations. Extent of silver ore is generally unknown.
Sodium Chloride	⊕	Potential source of salt is the Salton Sea area. Most production ceased by 1947
Sodium Sulfate	⊕	Durmid Hills, late Cenozoic lacustrine deposit steeply folded by displacements along the nearby San Andreas Fault.
Sulfur	S	Native sulfur found in Coyote Mountains and in the northeast portion of the County between the Chocolate Mountains and the Palo Verde Mountains.
Tungsten	●	Does not occur as native metal, chemically combined in 14 known minerals. There are known deposits in the Cargo Muchacho Mountains, the Chocolate Mountains, Jacumba Mountains, and Coyote Mountains.
Uranium	⧗	Eastern Salton Trough area has some limited deposits.

(U.S. Geological Survey, 1966)

SAND AND GRAVEL RESOURCES

Construction materials such as sand and gravel are high bulk, relatively low value resources. As the distance between the point of extraction and potential utilization increases, the cost increases significantly. Cost for these materials approximately doubles for each twenty miles it is hauled; the maximum distance that sand and gravel may be economically transported is about forty miles. Suitable sand and gravel deposits may exist in only a limited number of sites within the County; extraction will logically locate here. If these areas are not designated as resource areas and incompatable uses are permitted, they are essentially lost. When this occurs it is usallly reflected in higher costs of sand and gravel.

The areas indicated as suitable sources of gravel on the Mineral Resources Map are based upon Soil Conservation Service criteria. These include the percent gravel, number of inches of overburden, and thickness of material. Imperial County does not possess any deposits classified as "good," however "fair" sources of gravel are found in the Yuha area, along the Ancient beachline, and in alluvial fans at the base of the eastern mountains. This map is intended to show in general terms, the potential of an area as a source of gravel. The SCS criteria does not evaluate a deposit on the basis of gradation, quality, accessibility, or depth to water table; these must be examined on-site on an individual basis. Some deposits have been developed in the past and provide more precise information. (See Table 2). Generally speaking adequate quantities of usable sand are available along the ancient beachline. The dune sands are less suitable for concrete because its spherical shape restricts hardening.

While not of exceptional quality or suitability, available sand and gravel sources must be utilized to meet local-demand. If these resources are

wasted or "lost" the consumer will be forced to pay increased prices for imported materials. Quarries, sand and gravel pits, and "strip mining" type operations may have serious environmental consequences. The need to adequately provide for environmental maintenance will be discussed in Environmental Considerations in this section.

TABLE 2

SAND AND GRAVEL DEPOSITS

NAME & LOCATION OF DEPOSITS	TYPE & EXTENT	GENERAL FEATURES	ROCK TYPE (PERCENT)
GLAMIS DEPOSIT: Near Glamis	Alluvial fan, ranges from about 1 mile in width at head of fan to 6 miles near Glamis. About 8 miles long. Shallow deposit, 3' deep near Glamis, deepening to southeast. Presently utilized.	No overburden, no replenishment. Maximum size 4", occasional 2' boulders diminishing in size toward Glamis. Harshly angular particles.	Volcanic Rock 41 Granitic 34 Gneiss 21 Vein Quartz 2 Quartizite 2
PICACHO CREEK: Near Yuma	Intermittantly dry steambed deposit extends about 10 miles north from intersection with All American Canal. At least 15' deep. Crudely stratified thin beds of sand and gravel. Maximum 1/4 mile.	No overburden, same replenishment in flood stages. Maximum size gravel 3', occasional 6" boulders. Excess of sand over gravel, (about 2/3 sand).	Predominately granite and gneiss, with volcanic rock, quartz and quartzite.
SALTON SEA ANCIENT BEACH DEPOSIT: Generally along East Highline Canal	Ancient shoreline deposit comprises low ridge about 15' above surrounding plain. Extends for about 80 miles along the eastern edge of Imperial and Coachella Valleys. Deposit ranges from 100-300 yards in width (average 100 yards); and from 5' to a maximum depth of 35' above a claylayer bedrock. Crudely stratified thin beds of gravel and sand less than 1' thick dip a few degrees toward the Valley.	Slight veneer of fine sand overburden. Maximum size 3", diminishes to the south to about 3/4 maximum near Calexico. Usually coarsest material in center of deposit. Increase in maximum size generally with depth. Where developed, proportion of sand to gravel about 50%, decreasing toward the south. About 70% sand in deposits near Holtville.	Volcanic Rock 67 Granitic 27 Calcareous sandstone 4 Gneissic granite 2
SALTON SEA ANCIENT BEACH DEPOSIT: Western County, southwest of Westmorland.	Ancient shoreline deposit composed predominately of crudely stratified sand with minor amounts of fine gravel interbeds. Where developed, at least 15' deep. Bottom on clayey silt layer.	Little to no silty overburden. Predominately sand with minor percentage of gravel, up to 1½" maximum size. Sand is clean, well sorted medium coarse, weakly consolidated, uncemented grains of quartz, feldspar, and some mica. (State of California, Division of Mines and Geology, Bulletin 180-C, 1968.)	Calcareous sandstone 78 Pegmatitic granite 15 Gneissic granite 3 Quartzite 3 Granitic 1

LAND-USE CONFLICT

Uncontrolled urbanization has basically the same effect on mineral resources as it does on agricultural lands. The geographic extent of mineral resources is a function of geologic factors, thus mining operations are restricted to the relatively few locations of mineral deposits suitable for extraction. Urban development removes these resources from available reserves, at least for the foreseeable future. This loss results not only from land uses situated atop potential extractive sites, but also from incompatible land uses on adjacent property. Extractive operations such as for gypsum, sand, or gravel are particularly unwanted as neighbors by residential or commerical areas. Determination of the location, extent, and quality of mineral deposits is essential if they are to be protected from incompatible land uses.

The potential social and economic value of these resources are important considerations when conflicting land uses are proposed. Mineral extraction provides employment, increased tax revenue, increased demand for local goods and services, and minerals or other materials at reasonable prices. These Advantages must be weighed against the land requirements of other land uses and the possible impact upon the environment.

ENVIRONMENTAL CONSIDERATIONS

Extractive industry may have significant impacts upon the natural environment. Damage to the environment by extractive operations in other areas is well documented. Damage has often been the result of failure on the part of local or state government to effectively regulate these uses.

Air quality is of increasing concern to Valley residents. The extensive areas of dust and sand creates a high ambient dust level in the County although it is reduced in the irrigated area. Agricultural burning also contributes significantly to reduced air quality. Open or surface mining may produce excessive amounts of dust which will require effective control measures to mitigate or prevent deterioration of air quality.

Extractive operations may also accentuate geologic hazards. The possibility of subsidence resulting from extraction of geothermal water is discussed in the Geothermal Resources section of this Element. The possible effect of mineral extraction on surface and groundwater must also be considered. Mining operations must meet water quality standards established by the State Water Resources Control Board and the Regional Water Quality Control Board-Colorado River Basin Region. Regulations limiting discharge of mining waste materials generally prohibit pollution of ground or surface waters or creation of a nuisance situation. While local groundwater is generally unsuitable for most uses, care should be taken to insure against its further deterioration.

Recognition of public health and safety is important, particularly in view of the number of serious injuries resulting from abandoned mineshafts in the desert. If the mine is subsurface, the shaft should be sealed at the surface upon abandonment or completion of operations.

Mineral extraction, while often uncovering items of archeological significance, very often destroys the fragile setting and artifacts of the site. When considering applications for mineral extraction in areas of archeological or other scientific interest, an on-site evaluation of the sites

historical or archeological value should be provided by the applicant. Such information must be prepared by a qualified archeologist.

Extractive industry in the local context may be highly visible, therefore aesthetic requirements are particularly important. While many of these operations are open, they should be shielded as much as possible from public view. Review of the probable impact of extractive industry also requires that potential noise and impact on plants and wildlife be critically examined.

Plans for the future use or reutilization of the land after extraction should be required. Where feasible the site should be used for recreational purpose. If serving primarily as open space the land should be restored as near as possible to its natural state. Before approving any extractive operation, the County should require the applicant to submit a plan for the future use of the site. This plan minimally includes:

1. Proposed use subsequent to extractive operation and program and techniques directed toward this end.
2. Information on local topography and slope stability.
3. Soil drainage and permeability.
4. Water table characteristics.
5. Suitability for subgrade, fill, or borrow.
6. Compaction characteristics.

The County should not be left with an unsightly, unusable, and dangerous area when the extractive operation is completed. The standard of environmental quality that an extractive industry is required to maintain should be well defined in development and performance standards. Should the operation fail to meet or maintain these standards, appropriate penalties must be enforced.

POLICIES

1. Mineral resource potential should be an important consideration when land-uses are proposed for an area.

2. If an area is determined to be of significant mineral resource value, it should be designated on the Open Space Map, and appropriate zoning and other regulatory devices should be applied to protect it from urban encroachment. Only interim uses which would not preclude eventual extraction should be permitted.

3. Review, adopt, and implement detailed development and performance standards necessary to mitigate the several environmental problem areas associated with mineral extraction.

4. Prior to granting approval of an extractive operation, the County will require plans regarding the future use of the land once extraction has been completed. These plans should be guaranteed by the posting of bonds by the applicant.

5. In areas of suspected archeological importance, professional evaluation of the archelogical significance of a particular site is required prior to the approval or denial of an application to extract minerals.

LEGEND
URBANIZED AREAS
SAND OR GRAVEL POTENTIAL
FOR MINERIAL DEPOSIT SYMBOLS SEE TEXT ON PAGE 38.
RIVERSIDE COUNTY
SAN DIEGO COUNTY
IMPERIAL COUNTY
MEXICO
BB
S
L
K
P
MINERAL RESOURCES
SCALE IN MILES

CHAPTER V. LAND RESOURCES - SOILS

ISSUES

1. Extensive areas of County soils exhibit limitations which make them unsuitable or at least undesirable for particular land uses.

2. The nature and location of many existing or potential soil hazard areas are not well known.

3. Gully erosion resulting from diversion of washes and alteration of other natural drainage patterns by land development.

4. Wind erosion resulting from the disruption of the soil's surface crust in desert areas.

OBJECTIVES

1. Distribution of land uses based in part upon the capability of various soils to support them.

2. Minimize the possibility of adverse effects upon urbanization resulting from erosion, subsidence, shrink-swell, or other soil related hazards.

3. Provide for the protection of particularly fragile soils from wind and gully erosion.

SOIL CHARACTERISTICS

Imperial Valley is essentially a single physiographic unit, composed of a nearly flat basin surrounded on three sides by mountain ranges. Precipitation is usally intercepted by the Laguna Mountains to the west, although some rainfall does occur on their barren eastern slopes. Normally what rain that falls is from the Gulf of California and is of high intensity and short duration.

Different section of the County exhibit varied soil characteristics.

These have been generalized as follows:

1. West: Soils of the western portion of the County are classified into two broad categories. The first occurs on nearly level to moderately sloping alluvial fans, floodplains, and terraces. They are developed in old alluvial materials of mixed mineralogy although some are developed in recent alluvium or aeolian deposits. They are very deep, well drained and calcareous. There is a slight to moderate hazard of wind and gully erosion. Very few of the soils are cultivated or urbanized.

   The second broad category consists of highly dissected, rapidly eroding areas of non-consolidated materials with little or no vegetative cover. Some areas exhibit 25-90% rock outcrop and very shallow soils. There is a very high erosion hazard. Almost none of these soils are urbanized or cultivated.

2. Central: The soils of the Central County irrigated area are floodplain or old lake-bed deposits. Developed in alluvium of mixed mineralogy, they are very deep, highly calcareous, and usually contain gypsum and soluble salts. Drainage problems exist due to somewhat poor drainage under irrigation or high water tables. Little or no erosion hazard exists. Almost all of soils are cultivated.

3. East Mesa: The soils of the East Mesa occur on gently sloping to nearly level flood plains, terraces, alluvial fans, and basins. The soils are developed in recent alluvium and aeolian deposits of mixed mineralogy. They are very deep, somewhat excessively to well drained and calcareous. There is moderate wind erosion hazard. Very little of the soils are cultivated or urbanized.

4. East: The soils between the dunes and eastern mountains are on nearly level to gently sloping surfaces of basins, floodplains, terraces, and alluvial fans of mixed mineralogy. They are very deep, excessively to well drained, calcareous and usually contain soluble salts. They are dissected by gullies and drainage-ways; but are well protected from wind erosion by a dense gravel pavement covered with a dark desert varnish. Almost none of these soils are cultivated or urbanized.

5. Eastern Mountains: The Eastern Mountain area is composed of highly dissected and rapidly eroding materials of sandy loam and coarser textures. Some areas have 25-90% basic volcanic, granitic and metasedimentary rock outcrop. Erosion is extreme in high intensity rain storms except in areas of volcanic rock, where surface rubble

provides protection. In some areas low intensity rains result in little erosion due to the moderately rapid permeability of the materials. Almost none of the soils are cultivated or urbanized.

SOIL CAPABILITIES

Most of the information contained in this section is based upon a general soil survey conducted by the Soil Conservation Service. This survey provides information useful for general planning purposes, but does not define soil characteristics of particular sites or locations. Where the general soil survey indicates that areas of significant soil limitations may exist, detailed on-site surveys may be required. The Soil Conservation Service has more detailed soil maps of the Central area available. It also identifies some types of soil limitations by on-site investigations. A system of recording and cataloging this information within the department would enhance a long-range program of more exactly determining the land suitability of specific areas.

Soil characteristics and qualities which restrict land uses include the chemical make-up of the soil, texture or partical size, natural drainage, erosion hazard, permeabiltity, inherent fertility, slope, and depth. Soil characteristics have been analyzed and the suitability for several purposes determined. These include:

1. Land capability classification (primarily for agricultural purposes)
2. Vegetative soil groups
3. Hydrologic soil groups
4. Limitations for septic tank filter fields
5. Limitations for sewage lagoons
6. Shrink-swell susceptibility
7. Soil corrosivity for untreated steel pipes

Several of these characteristics greatly influence urban form. Existing soil limitations should be considered before any propsed development is approved. Table 1 described in general, the dominant characteristics and qualities of Valley soils.

TABLE 1

LAND CAPABILITY UNITS

SOIL NAME	SOIL TYPE	CAPABILITY UNIT*	GENERAL SOIL QUALITIES AND CHARACTERISTICS
Meloland-Gila Association (hummocky, 0-5% slopes)	Mx-Gi-AB	II s 3	Very deep, well drained, medium to moderately coarse textured, gently to moderately sloping soils with slowly permeable substrata. Soils of this unit have loam to loamy fine sand surface textures and are underlain at 18 to36 inches by slowly permeable strata of silty clay or clay loam. Available water-holding capacity for the profile is 10 to 15 inches. Erosion hazard is slight. Soil reaction is P^H 7.8-8.3. All locally adapted crops may be grown except orchard.
Gila-Vinton Association, (hummocky) Brazito-Vinton Association	Gi-Vo-A BM-Vo-A	II s 4	Very deep, somewhat excessively well drained, moderately coarse textured, nearly level soils. Soils of this unit are very deep, somewhat excessively well drained, permeable soils with no physical features limiting root and water penetration. Available moisture is about 6 to 7.5 inches for a 5-foot depth. All locally adapted crops are suited to these soils.
Holtville Association (wet) Gila-Vinton Association (wet)	Ht-Awl Gi-Vo-Awl	II w 5	Very deep, moderately well drained, medium to moderately fine textured, nearly level soils. Soils of this unit are very deep permeable soils with no physical features limiting root and water penetration to a depth of 5 feet. Drainage has been altered by seasonal high water tables due to irrigation. Water tables with attendant salt accumulation require artificial drainage. Available moisture is 7.5 to 12 inches for a 5-foot depth. All locally adapted crops may be grown after adequate drainage installation and initial salt reduction.
Glendale-Imperial Association, (0-5% Slopes, eroded)	Go-Im-AB2	III e 5	Very deep, moderately well drained, fine textured, gently sloping soils. The soils of this unit have silty clay or heavy silty clay loam textures with slow permeability. Available moisture is about 12 to 16 inches for the 5-foot profile. Reaction ranges from P^H 7.8 to 8.2. Soluble salts are often present. There is a moderate hazard of water erosion. Salt-tolerant crops are best adapted.
Vinton-Brazito Association, (hummocky, 0-5% slopes) Superstition-Acolita Association (hummocky) Duneland Association	Vo-BM-AB1 ss-Ab-A DL	III s 4	Very deep, somewhat excessively drained, moderately coarse to coarse textured, nearly level to gently sloping soils. The soils of this unit have fine sand or loamy sand textures. Available moisture is about 5 inches for the 5-foot profile. Reaction ranges from P^H 7.8 to 8.2. There is a moderate hazard of wind erosion. Essentially all adapted crops may be grown.
Meloland-Gila Association, (wet)	Mx-Gi-Awl	III w 3	Very deep, nearly level, imperfectly drained, moderately coarse to medium textured soils with slowly permeable substrata. The soils of this unit have altered drainage due to irrigation and permeability restrictions in the subsoil. Available moisture is 10 to 15 inches in the 5-foot profile. Reaction ranges from P^H 7.8 to 8.2. There is a slight hazard of wind erosion. Closely spaced drains and careful irrigation management are needed for salinity control. All adapted field crops may be grown. Orchard crops, except for dates, are not recommended.
Gadsden Association (wet) Glendale-Imperial Association (wet) Imperial Association (wet)	Ga-Awl Go-Im-Awl Im-Awl	III w 5	Very deep, somewhat poorly drained, fine textured nearly level soils. The soils of this unit have altered drainage due to irrigation and permeability restrictions in the subsoil. Available moisture is 7.5 to 16 inches in the 5-foot profile. Reaction ranges from P^H 7.8 to 8.2. Closely spaced drains and careful irrigation management are needed for salinity control. All adapted field crops may be grown. Orchards are not recommended, except for dates.
Niland-Imperial Association (0-5% slopes eroded)	Nl-Im-AB2	IV e 3	Very deep, somewhat poorly drained, gently sloping coarse to very coarse soils with slowly permeable substrata. Soils of this unit have gravelly loamy sand or coarse loamy surfaces underlain by slowly permeable substrata at depths of 18 to 36 inches. Moisture-holding capacity of the 5-foot profile is 11 to 13 inches. Soil reaction ranges from P^H 7.8 to 8.3. Soluble salts are often present in injurious amounts. This unit is often dissected by gullies, leaving only small areas suitable for cultivation in a natural state. There is a moderate hazard of water erosion. This unit is marginal for production of general field crops

TABLE I

LAND CAPABILITY UNITS (Continued)

SOIL NAME	SOIL TYPE	CAPABILITY UNIT	GENERAL SOIL QUALITIES AND CHARACTERISTICS
Bittersring-Harqua Association (0-5% slopes)	By-HN-AB	IV s 0	Shallow, well drained, nearly level to gently sloping soils, with very gravelly substrata. The clay loam soil above the very gravelly substrata can hold about 2.5 inches of water that plants can use, but would require leaching of soluble salts before crops could be grown. The very gravelly substrata are probably limiting to root growth. Shallow rooted grasses and grains are probably the best adapted crops.
Carrizo-Cajon Association Carrizo-Cajon Association (2-9% slopes) Rillito-Orita Association (0-9% slopes)	Cr-Cd-A Cr-Cd-BC Rz-Os-AC	IV s 4	Very deep, excessively to somewhat excessively drained, rapid to very rapid subsurface permeability, very coarse soils. The soils of this unit are calcareous, coarse gravelly sand and gravelly loam. Choice of plants are limited by drouthiness and low fertility. Soils have less than 7 inches of available water holding capacity.
Niland-Imperial Association (wet, 0-5% slopes)	Nl-Im-ABw	IV w 3	Very deep, somewhat poorly drained, nearly level to gently sloping, coarse to very coarse soils with slowly permeable substrata. Soils of this unit have loamy sand or coarse loamy sand surfaces underlain by slowly permeable substrata at depths of 18 to 36 inches. Drainage has been altered by irrigation. Moisture-holding capacity of the 5-foot profile is 11 to 13 inches. Soil reaction ranges from p^H 7.8 to 8.3. Closely spaced drains are needed for salinity control. Favorable air drainage permits growth of frost-sensitive crops. This unit is marginal for production of general field crops.
Playa Association	PY	IV w 5	Very deep, somewhat poorly drained, fine textured, nearly level soils. The soils of this unit have restricted drainage due to slow subsoil permeability and ponding or slow run-off. The soils hold about 12 inches of water that plants can use, but drainage and toxic salt reduction practices are necessary for successful management. Many areas need surface drainage or protection from run-off. Salt tolerant crops best adapted.
Rough Broken Land Association	RB	VI e 1	Very deep, excessively drained, coarse textured, steep soils. The soils of this unit are easily eroded, and have many slopes of over 15 percent. They usually can hold less than 3 inches of water that plants can use. They are unsuited to general crops, but may have some potential for specialty crops under intensive management.
Badland Association	BZ	VI e 5	Very deep, well drained, fine textured, steep soils. The soils of this unit are easily eroded and have many slopes of over 15 percent. They usually can hold more than 7.5 inches of water that plants can use, but would require toxic salt reduction in most places. They would require heavy investments in land shaping, irrigation, and drainage systems to have any potential for crop production
Lava Rockland Association Rockland Association	LP RL	VIII e 7	Coarse-texted gravelly soils or Rock Land. This unit includes Rock Land and soils too coarse to be considered irrigable.
Alluvial Land Assoc.	AZ	VIII w 2	Alluvial Land and Playas. Soils in this unit are imperfectly to poorly drained and moderately to strongly saline alkali. They are usually more that 5 feet deep. Drainage is not feasible. Land is suitable for wildlife use.
*Dominant Interpretation for Irrigated Soils			(U.S. Department of Agriculture, Soil Conservation Service, 1967)

LIMITATIONS ON LAND-USE

Soil characteristics must be evaluated with particular land-use in mind. For example, allowable soil pressure has little effect upon irrigated agriculture; it would be of primary importance were a highrise structure contemplated.

Steep or excessively flat land does not preclude development, however construction in these areas generally entails greater investment. Total investment includes not only the cost of the structures but also site preparation, site development, utility services, and provision of drainage facilities and access roads. This investment in physical construction in certain areas is not the sole factor in determining the feasibility of development, however it is a significant consideration. Few steep slopes which would present potential difficulties are found in the urban areas of the County, however excessively level lands do pose problems. Generally speaking a slope of less than 1% drains poorly; this difficulty may be compounded by the run-off characteristics of particular soil types. Most of the urban areas are located on exceedingly level terrain. While annual precipitation is minimal, it is often very intense. The level terrain, soils of low permeability, and large quantities of rainfall over a short period result in flooding in some areas, a notable example is the Winterhaven area. The Ocotillo area has numerous major and minor washes which may present serious hazards if development is permitted in their path. Development in these areas must devote particular attention to these physical limitations.

Soil characteristics may create conditions which endanger structures or inhabitants. Two primary areas of concern are susceptibility to shrink-

swell and limitations on allowable soil pressure. Soils which exhibit these two limitations are considered unstable and are identified in the Open Space Element. The location and extent of unstable and unsuitable soils and geologic hazard areas will be expended upon in the Safety Element.

Desert soils form a shallow, fragile crust or "pavement" which serves to reduce wind erosion. When this poorly developed layer is disturbed, for instance by off-road vehicles, susceptibility to wind erosion is greatly increased. While significant amounts of dust or sand are not normally moved for great distances, removal of soil may continue until the next substantial rainfall re-establishes the crust.

The management of soils is important for controlling erosion, increasing soil productivity, assisting in watershed management and flood control, and aiding in the rehabilitation of eroded or damaged areas.

Soil characteristics do not dictate the type of development that a particular site may accomodate, however, it does have a significant influence. The costs of overcoming severe soil limitations may make the site economically unfeasible for certain land uses. As development pressure intensifies, the engineering and design necessary to overcome these limitations may be economically justified.

POLICIES

1. Soil characteristics and limitations are integral factors in determining the desirability and suitability of a proposed land use.

2. Direct land uses into areas which are intrinsically suitable and capable of supporting them.

3. Provide for the regulation of development or development practices that may increase wind or gully erosion or diminish the usefulness of local soils.

4. Assure that proposed subdivisions or other development are properly engineered in respect to identified soil limitations.

5. Begin a program of recording and cataloging soil information on particular sites so that a more accurate, precise determination of land suitability is possible.

6. Support the goals, policies, and programs of the Soil Conservation Service which contributes to the implementation of the Conservation Element.

7. The disturbance of fragile soils and groundcover in desert areas is of significant concern. The County concurs in principle with the Bureau of Land Management's Off-Road Vehicle Plan.

CHAPTER VI. LAND RESOURCES-AGRICULTURAL LANDS

ISSUES

1. Continuing loss of agricultural lands to urbanization resulting from rural lot splits and approval of subdivisions outside of urban limits.

2. Incompatible nature of agriculture and urban uses when in close proximity to each other.

3. Possibility of reduced agricultural variety and productivity due to increasingly saline irrigation water.

4. Availability of adequate quantities of suitable irrigation water from the Colorado River.

OBJECTIVES

1. Preserve the majority of productive agricultural lands for the purpose of providing food and fiber to local, state, and national markets.

2. Preserve and enhance the agricultural base of Imperial County.

3. Retain the major portion of agricultural acreage currently in production. Also preserve major areas of Class II and III soils which are currently unirrigated but which offer significant potential when water is made available.

RESOURCE POTENTIAL

Favorable **climate**, productive soils, and the availability of irrigation water has permitted Imperial County to become a leading producer of agricultural products. During 1972 Imperial County produced almost 120 million dollars in livestock and dairy products and had 17 crops with production over 1 million dollars. The majority of industry in the County is directly associated with agricultural production; land-use decisions which jeopardize agricultural production indirectly jeopardizes local industry.

Technological improvements and high labor costs have encouraged the trend toward farm mechanization. To operate efficiently, these operations require extensive acreages, a trend that has been evident in Imperial County for some-time. Between 1949 and 1964 the percentage of farms in excess of 500 acres increased from 9.7 percent to 31.4% of the total. The total number of farms declined from 2937 to 942 during this period. (Koebig & Koebig Inc. 1970). The limited quantity of irrigation water, which itself may be reduced in the future, precludes significant expansion of irrigated acreage unless new sources of water are made available.

Although there are some limitations imposed on crop types by salinity and extreme temperatures, irrigated agriculture permits man to regulate important factors in plant growth. The lack of precipitation for instance, permits the measured application of water at the most advantageous times. This manipulation of growing factors greatly increases the productivity of farmlands, and on the average one acre of irrigated land is equivalent to three acres of non-irrigated farmland. (United States Geological Survey, 1966).

The steadily increasing salinity of irrigation water may reduce production of crops such as citrus and cabbage to levels where they could not compete economically with those produced elsewhere. Even the production of more salt-tolerant crops such as lettuce, cantaloupe, barley, sorghum, and tomatoes could be significantly reduced. The continued availability of adequate quantities and quality of irrigation water is not guaranteed, and any reduction will be reflected in the productivity of agricultural lands.

AGRICULTURAL SOILS

Imperial County soils are complex and no true profile exists. The alluvial soils are interwoven with aquifers, aquicludes, clay barriers , and sand lenses. There is no clearly identifiable gravel and sand water-bearing stratum.

One soil type does not ordinarily extend over a large area, but is found instead in "pockers" or "lenses". Salt, transported and deposited by irrigation waters, accumulates in these layers of soil. (Imperial Irrigation District). The Report for the General Soil Map - Imperial County, California - 1967, provides detailed information concerning the agricultural suitability of soil types aggregated into capability classes.

Soil Reclamation. During the early days of irrigated agriculture in the Valley water-deposited salt gradually accumulated in the soil. By 1922 a substantial amount of acreage had been removed from production. That year a system of drainage ditches was begun to remove these salts, and today totals almost 1400 miles in length. The finely textured soils of the Valley exhibit poor drainage characteristics which restrict the movement of the soluble salts. In 1929 a system of subsurface tile drains was begun and has proven largely effective. The salt is moved through the soil by the application of water in excess of that which may be utilized by the crop. The continually increasing salinity of irrigation water, coupled with the possible reduction in the quantity of water available, portend continuing difficulties in combating salt accumulation. Possible alternative approaches to these problems are discussed in Water Resources - Irrigation Water, of this Element.

Once the land has been reclaimed, effective agricultural management practices are necessary to assure it's continued productivity. These include special planting and bedding methods, special irrigation practices, and the selection of salt tolerant crops. Table 1 indicates the relative salt tolerance of several crop types.

TABLE 1

RELATIVE TOLERANCE OF CROP PLANTS TO SALT

Low Salt Tolerance	Medium Salt Tolerance	High Salt Tolerance
Pear	Pomegranate	Date Palm
Apple	Fig	Salt Grass
Orange	Olive	Bermuda Grass
Grapefruit	Sweet Corn	Rescue Grass
Prune	Potato (White Rose)	Western Wheatgrass
Plum	Carrot	Barley
Almond	Onion	Sugar Beet
Apricot	Sudan Grass	Rape
Peach	Alfalfa (California common)	Cotton
Strawberry	Rye	
Lemon	Wheat	
Avocado	Oats	
Field Bean	Orchardgrass	
Radish	Rice	
Celery	Meadow Fescue	
Meadow Foxtail	Sorghum (grain)	
Red Clover	Corn (field)	
	Flax	
	Sunflower	
	Castorbean	

Based on Agriculture Handbook No. 60, U. S. Department of Agriculture.

AGRICULTURAL-URBAN CONFLICT

A significant portion of Imperial County is suitable for agricultural production if adequate quantities of irrigation water were available. The definition of "prime agricultural lands" in this element differs from that of Section 51201 C of The California Government Code. In many instances Class III soils have been included in the RMP because of favorable climatic conditions and the potential availability of irrigation water. For the purpose of implementing the California Land Conservation Act of 1965, the definitions of Section 51201 C are controlling.

Class II soils are scattered in the northwest, west-central, and southeast portion of the irrigated area; the San Felipe Creek Areas; in the vicinity of the Salton Sea Test Base, and the Bard area. While some of these Class II soils are presently not irrigated, they do warrant preservation. Class III soils compose the dominant portion of the central county, and approximately 90% of the irrigated area. An extensive area of unirrigated Class III soils is located east of the Highline Canal. Barring the availability of substantial amounts of irrigation water from a new source, noticeable expansion of irrigated acreage appears unlikely. The Open Space Element delineates Prime Agricultural Lands which must be protected. While some of this land will be needed for non-agricultural uses, great care should be taken to assure that these lands are not lost to speculative investment of any type. Prime agricultural lands have been under extreme pressure for urbanization. The problem lies not so much in urbanization per se, but in the fact that it is occurring on our best agricultural soils. During the past two decades between thirty-/and forty-thousand acres of land were required for urban development in California; about half of this has resulted in the direct loss of productive agricultural land. (Department of Water Resource, December 1970) Such development is shortsighted and wasteful, permanently removing land from agricultural production. Agricultural production on lands of poorer quality requires that more acreage be irrigated, resulting in a concomitant increase in demand for irrigation water. Agricultural lands should be protected from urban development even within the urban limits of a municipality unless designated for a non-agricultural use in a current land-use plan or the RMP. Of primary concern are rural lot-splits and the approval of subdivisions outside or at the periphery of defined urban limits. The rural lot-split and subdivision introduce incompatible uses into agricultural

areas and threatens their continued productivity. The incumbent agricultural use becomes the "nuisance" and is forced to adhere to specified controls on its operations. Much of the land classifed as agricultural has been broken into one to twenty acre parcel, usually too small to economically farm and too large to serve as functional yard area. These parcels are often under-utilized and become eyesores, collecting junked automobiles, scrap building materials, trash, and weeds.

Transitional uses and restrictions are required to reduce the conflict apparent where rural and urban areas meet. Development at the defined urban limits often creates areas of incompatibility. While these limits indicate the future extent of urban uses, development in this area should proceed in an orderly fashion. Approval of subdivisions at the outer limits of this area creates problems of efficiency in providing services as well as reducing the viability of the remaining agricultural land.

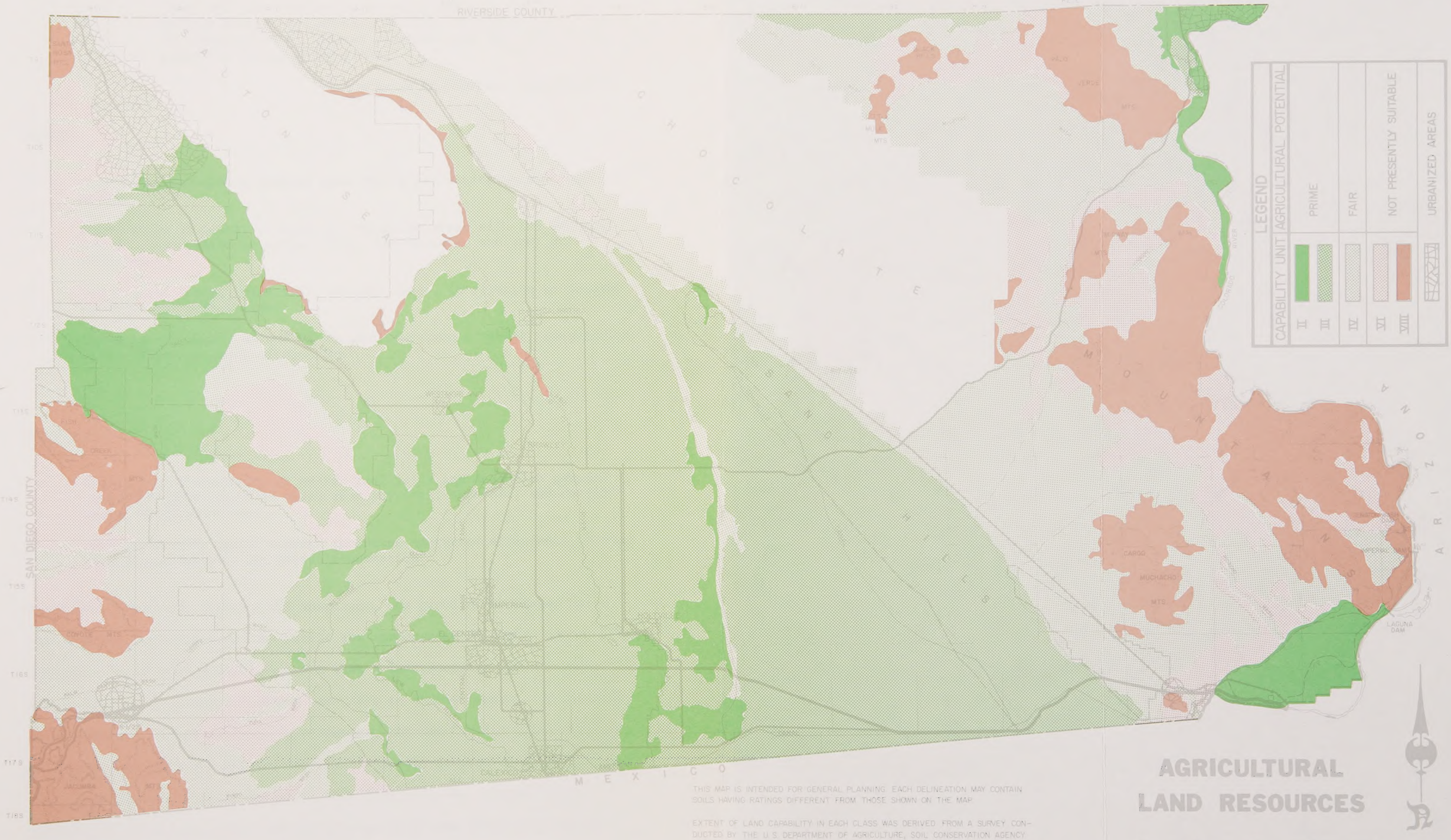
POLICIES

1. Land suitable for irrigated agricultural is perhaps the most significant natural attribute of the County and it's protection and enhancement is in the best interests of all County residents.

2. Applications for rural lot-splits below an accepted minimum acreage, as well as isolated subdivisions outside urban limits, should be denied.

3. Proceed in the development and preparation of an Agricultural Element. This includes delineation of various categories of agricultural land uses and minimum acreages intended to serve different agricultural operations.

4. Preservation of agricultural lands in the long run is dependent upon public understanding and commitment. The County should encourage these attitudes by a program of public education regarding the long and short term benefits of land-use decisions of this type based upon resource protection and enhancement.



AGRICULTURAL LAND RESOURCES

THIS MAP IS INTENDED FOR GENERAL PLANNING. EACH DELINEATION MAY CONTAIN SOILS HAVING RATINGS DIFFERENT FROM THOSE SHOWN ON THE MAP.

EXTENT OF LAND CAPABILITY IN EACH CLASS WAS DERIVED FROM A SURVEY CONDUCTED BY THE U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION AGENCY CO-OPERATING WITH THE IMPERIAL IRRIGATION DISTRICT AND THE BARD AND PALO VERDE CONSERVATION DISTRICTS.

0 4 8 12 16
SCALE IN MILES

CHAPTER VII. ENERGY RESOURCES

> "More and more people are becoming aware of the linkage between pollution, the hasty and wasteful consumption of limited resource, and the growth of energy consumption. . ."
>
> (Energy in California, January 1973)

ISSUES

1. Increasing population coupled with rising per capita consumption of energy.
2. Exportation of energy to major metropolitan areas with the environmental consequences of energy production borne by the area of generation.
3. Power plant siting, especially nuclear sites, in relation to seismic and geologic hazard areas.
4. The negative visual effect of the proliferation of power transmission lines across expanses of open land.

OBJECTIVES

1. Recognize the necessity of energy facilities and establish general areas for their location based upon physical, economic, and environmental considerations.
2. More economical use of energy, including increased efficiency of conversion and reduced per capita consumption.

Blackouts, brownouts, heating oil shortages, and gasoline shortages have all recently impressed upon the public the seriousness of the so called "energy crisis". It is increasingly apparant that a comprehensive plan for the development of a variety of energy resources is sorely needed. Obviously, these programs are of national significance, and the Federal Government may be expected to bear the primary responsibility for program development and implementation. It is essential that localities be afforded the opportunity to provide input regarding their goals and objectives relative to the development of these resources.

RESOURCE DEMAND

Energy demand is an expression of population; as the population increases the demand for energy increases. Between 1970 and 1985, California population has been projected to increase by 30%, from 19.7 million to 25.6 million people. Energy demand for the same period is expected to double. This increase may in part be attributed to an extraordinary increase in the 20-34 age bracket, historically the largest consumer of energy. This age group is expected to increase from the current 27 percent to 34 percent of the total state population. Imperial County may not experience this magnitude of increase as the 20-34 age group accounted for only 17.4% of the County's total population in 1970. While this proportion may be expected to increase somewhat as the result of urbanization, limited educational and employment opportunities will limit it's expansion. The total energy load has tended to increase by 80% and the peak load to double, every ten years. Perhaps the most important factor in this increased demand is increased per capita use. The necessity of refrigerated air-conditioning and demand for other electrical convenience items may be expected to place increasing burdens on available energy resources. Between 1970 and 1985, per capita use of energy in California is expected to increase by 54%. The Imperial Irrigation District, in addition to supplying water for domestic use and irrigation, provides electrical energy to urban and rural areas of the County. The average consumption by IID customers is extremely high with average annual domestic consumption at 12,000 kwh. The nameplate ratings of IID power plants total 293,880 Kilowatts. The availability of energy transcends local concern, consequently it will be necessary to consider energy requirements on more than a local basis. The rapidly expanding urban areas of Southern California, specifically San Diego County, will place additional demands upon available energy resources.

The possibility of geothermal or nuclear plants within Imperial County for the purpose of supplying this energy should be carefully studied to determine the long-term implications of such development.

ENERGY RESOURCES

There are basically two categories of energy; solar energy and terrestial energy. The former is primarily in the form of fossil fuels, while the latter includes the hydraulic force of water, geothermal fluids, and nuclear energy.

Fossil Fuels. The fossil fuels, oil and gas, supplied 89% of the total energy requirements in California in 1970. By 1985, despite the development of additional sources, it is presently projected that fossil fuels will still supply about 77% of the total. There are no known available fossil fuel reserves in Imperial County. Although IID utilizes these fuels at the Brawley and El Centro stations, energy is derived from imported sources. Two 790 mw thermal coal-fed power plants have been constructed at Mohave. IID has expressed interest in the possibility of inter-ties between these plants and the west coast, which would offer the possibility of an IID substation to utilize some of the energy.

FOSSIL - FUEL PLANTS

Present Thermal Plants	Nameplate Rating in Kilowatts
E. C. Steam Plant (IID)	186,000
Brawley Diesel Plant (IID)	34,500
Axis Plant (Arizona) (1/3 IID)	25,000

Hydro Generation. In 1970 water power provided 9% of the total energy supply in California and 36% of the electric utility market. Hydro gener-

ation accounted for 34% of the energy resources available in Imperial County in 1970. In 1970, 104 million Kwh/day were generated in California, and an additional 31 million Kwh/day were imported from Arizona and the Pacific Northwest. The IID hydroplants annually produce in excess of 225 million kilowatt hours. This source of energy is expected to increase by only about 8.2% by 1985 due to the scarcity of sites in the state that are sound in respect to engineering and economics, and which are environmentally acceptable. Approximately 90% of the hydro potential available at drops along the All-American Canal has been developed by Imperial Irrigation District and the U.S. Bureau of Reclamation (at the Siphon Drop Plant). Drop sites 1 and 5 on the All-American Canal are undeveloped, however cost studies indicate they would be economically infeasible. Estimated costs of construction at these drops would exceed $800 per kilowatt compared to $130 per kilowatt for conventional steam. IID projects adequate energy capability through 1976. Drop 1 on the Coachella Canal offers some potential, however the loss of head which would occur should this canal be concrete lined, which appears likely, would negate this potential.

HYDRO-ELECTRIC PLANTS

Present Hydro Generation Sources	Nameplate Rating in Kilowatts
Pilot Knob (IID)	33,000
Drop No. 2 (IID)	10,000
Drop No. 3 (IID)	9,800
Drop No. 4 (IID)	19,600
Double Weir (IID)	560
Turnip (IID)	420
Glen Canyon (USBR)	23,200
Davis Dam (USBR)	30,000

Geothermal Energy. Because of the multifaceted character of the geothermal resource, the energy potential is discussed in the Geothermal Resources Section of this Element and in the proposed Geothermal Element.

Nuclear Energy. In 1970 nuclear plants accounted for only .7% of the total energy demand in California, and only 3% of the electric utility market. By 1985 it is expected to fulfill 13% of total energy demand and 40% of the electric utility market. The thermal efficiency of nuclear plants is only about 30%, approximately 10% less than that of fossil fuel.

There has been some interest expressed in the possibility of siting a nuclear plant within Imperial County, either in the vicinity of the Salton Sea or the Colorado River. While at present this is no more than a possibility, it does point out the need for reliable environmental data. Any proposed nuclear plant should be critically examined to determine the probable environmental consequences. Imperial County has areas of very high seismic activity, which would require extensive precautionary measures before development. While the possibility of nuclear accident is very remote, development along active fault areas could pose significant problems.

Nuclear plants require large quantities of water for cooling purposes. When this water is subsequently discharged, its temperature usually exceeds that of the receiving waters. The result may be thermal pollution of the lake, river, or stream, a condition which encourages algal bloom and reduces the suitability of the aquatic habitat. Such pollution could have severe consequences for the fisheries of the Colorado River or Salton Sea.

The question of energy supply is of local, regional, state, and national significance. Energy produced at a nuclear plant would doubtlessly be used

primarily to meet demand in the urban areas along the coast. While such development is desirable from the perspective of total energy supply, degradation of one area to benefit another is clearly unacceptable. The environmental degradation of the Black Mesa and Four Corners area in Arizona illustrates the potential impact of such development. This awareness does not diminish the possibility or necessity of future energy resource development. It does serve to point out the necessity of carefully examining proposals to determine the potential long-term consequences.

Solid Waste Conversion. The feasibility of producing oil or synthetic natural gas from solid waste is presently being studied by government agencies and private industry. In 1967, 72 million tons of solid waste was produced in California, by the year 2000 this may equal 125 million tons. (Resources Agency, 1973) A recent project by the U. S. Bureau of Mines produced 2 barrels of low-sulfur oil per ton of dry organic waste. Another project in 1971 produced oil from agricultural wastes, wood, lignin, and manure. With the quantity of agricultural wastes available in Imperial County, this could be a valuable development. More research is required to determine the optimum condition of temperature, pressure, water content of charge, and carbon monoxide consumption before the economic feasibility of this source is proven. San Diego County has contracted to have a small scale plant of this type in operation by November, 1974.

Solar Energy. An extensive source of energy is available in Imperial County in the form of sunlight or solar radiation. If this source can be developed Imperial County would have a large supplemental source of energy. Technological development to this point has not been successful enough to economically produce electrical energy, and utilization of this source does not appear probable in the near future.

TRANSMITTION FACILITIES

Present technology requires that transmission lines of 115 KV or higher be placed above ground. These lines may detract significantly from the scenic desert landscape, therefore considerable attention should be directed toward their design and placement. The transmission lines through the Algodones Dunes, an area of unique landscape value, are particularly detracting. New high voltage lines should utilize previous rights-of-way wherever possible, and the grouping of lines into designated corridors should be required.

ENERGY CONVERSION AND CONSERVATION

A responsible program of energy conservation requires that available energy be utilized in the most efficient manner possible. Increased efficiency in the conversion of forms of energy offers a substantial increase in potential energy. The efficiency of conversion of hydroelectric is 85%, nuclear 30%, and steam 33%.

The reduction of per capita consumption offers the most promising opportunity for energy conservation. Many possible methods to reduce demand have been mentioned, including a tax on horsepower, restricting construction of new facilities, limiting development of resources, and prohibiting advertising by energy suppliers. Certainly in view of increasing demand, advertising to encourage additional consumption is detrimental to the public interest. The production and marketing of an ever increasing variety of convenience appliances has tremendously increased energy consumption. Conservation of energy requires a personal committment on the part of individuals to use only essential appliances and to utilize more human energy.

POLICIES

As is true of other resource categories, there is no shortage of energy supplies. What is limited is an energy source whose utilization is economical and whose impact on the environment is minimal. A variety of potential sources exist, and technology is expanding the list, but it is essential that a balanced program of energy conservation and development be formulated.

1. Encourage the exploration and development of new types and sources of energy such as geothermal and solid waste conversion consistent with the protection of the natural environment.

2. If locally produced energy is to be transmitted outside of Imperial County, the County should receive assurance from the State or regional authority that it will not be required to bear excessive economic or environmental costs. A State or regional power organization has the authority to determine the need and location of facilities as part of a state or regional system of energy supply.

3. Examine with governmental and private energy suppliers, the feasibility and desirability of certain areas within the County as energy facility sites.

4. Formulate stringent controls and guidelines to assure that energy exploration, generation facilities and transmission lines will not have a deliterious effect upon the natural environment of Imperial County.

5. The County should review it's energy requirements, both for stationary and mobile sources, and examine ways to reduce consumption.

CHAPTER VIII GEOTHERMAL RESOURCES

> Geothermal resources are the natural heat of the earth, the energy in whatever form, below the surface of the earth present in, resulting from, or created by, or which may be extracted from such products obtained from naturally heated fluids, brines, associated gases, and steam, in whatever form, found below the surface of the earth but excluding oil, hydrocarbon gas, or other hydrocarbon substances.
>
> From: California Public Resources Code
> Chapter 1398, Section 6903

ISSUES

1. Long and short term social, economic, and environmental effects resulting from development of geothermal resources intended to satisfy local and regional demand.

2. Authority of Imperial County to require adherence to it's regulations and conditions on lands leased by the Federal Government is unclear.

3. Possibility of subsidence or seismic activity induced by extraction or reinjection of geothermal fluids.

OBJECTIVES

1. Provide for the maximum feasible development of geothermal energy, water, and minerals while assuring the maintenance of environmental quality.

GEOLOGIC FACTORS

Imperial County is situated in what is known as the Salton Trough, a structural depression which extends from the Transverse Ranges on the north to the Gulf of California on the south.

The Penninsular Range forms the western boundary; the Colorado and Sonoran Deserts the east. The Salton Sea Trough is structurally characterized by:

1) Very high heat flow locally through the earth's crust. These high temperature areas are identified as the North Brawley, East Brawley, Heber, Border, Dunes, Mesa and Buttes anomalies.

2) Thinning of the crust.

3) Accumulation of several thousand feet of Upper Tertiary and Quaternary sediments in a low-lying plain.

4) Major northwest trending faults.

(State of California, Division of Mines and Geology, July 1967)

It is thought that the intense heat in the deeper crust or upper mantle is transmitted upward through the water saturated sediments by convection cells. As this super-heated water nears the surface, it's upward movement is inhibited by relatively impermeable clays, shale, and volcanic units. This insulating layer prevents rapid dissipation of the geothermal water and heat to the surface. The water in the deep sediment is probably derived from run-off from the nearby mountain ranges and the Colorado River and is not connate water as was presupposed. It has been estimated that the geothermal reserves cover an area of approximately 3100 square miles.

Available geologic and hydrologic data is not as yet sufficient to accurately define the extent and quality of the geothermal resource. The areal extent, the storage and transmissive characteristics of the strata, and its vertical and horizontal variation is only part of the information necessary to determine the feasibility of geothermal development.

RESOURCE POTENTIAL

This section deals specifically with the geothermal resource because of its multiple resource potential, including energy, water, and minerals. Development would ideally utilize all three features, however technological limitations and uneconomic production costs of minerals may make this infeasible. The possibility of geothermal development on a large scale is dependent upon technology's ability to overcome certain problems.

Although the temperature, pressure, and chemical composition of the brine solution varies considerably, exploratory wells indicate that the geothermal resource generally meets the minimum technical requirements for feasible electrical energy production.

The geothermal brine utilized at Cerro Prieto, Mexico is of low salinity and poses few problems of corrosion and scaling, however the suitability of the brine for energy and desalinization declines markedly toward the north. The deep brine in the Buttes thermal area is very hot and hypersaline, often exceeding 250,000 ppm of salts. Utilization of this brine presents enormous problems of scaling and corrosion. Dr. Rex of the University of California - Riverside, postulates that a shallow brine reservoir may overlie the deep hypersaline brine in some areas. This brine is believed to be cooler and less saline, with only 10-30,000 ppm salts. The corrosive nature of the brine, coupled with the deposition of silica and other materials, presents a significant obstacle to energy and water production. Because of these problems the expected life of steam wells is limited to between 5 and 20 years. It is projected that between 10,000 and 30,000 megawatts of electrical energy could be produced annually if the resource were fully developed. Geothermal energy, though relatively low cost during production, requires extensive capital investment.

The initial temperature of geothermal waters is extremely high, and as the fluid reaches the surface reduced pressure and high temperatures cause it to "flash" to steam. This is recoverable as desalinated water. The amount of brine that "flashes" is determined by its temperature and chemical composition. The brine found in the southern portion of the Valley is of lower salinity and more suitable for desalinization. Estimates of the total usable and recoverable water in the Imperial Valley, based upon varying assumptions, ranges from 1 to 4.8 billion acre feet. The portion of this which has a temperature in excess of 302°F is approximately 200 million acre feet. U. S. Geological Survey estimated that 1.1 billion acre feet of reserves are available; 20% of this would provide 1 million acre feet of water for 200 years. (The Resources Agency, 1973) These geothermal resource could theoretically provide vast quantities of usable water to the Valley for a range of purposes.

The Bureau of Reclamation is presently studying the feasibility of geothermal production. Having begun in 1972, the evaluation studies are scheduled for completion in Fiscal Year 1978. A pilot plant near Holtville began producing water at 350 ppm of dissolved solids in mid-1973. Brine entering the desalinization facility averages 20,000 ppm salt, somewhat less than ocean water.

Geotherma reserves are believed to be sufficient to supply water and power for between 100 to 850 years. This period could be extended or doubled if the "recharging" of the geothermal reservoir with imported water is proven acceptable. The development of information regarding the geothermal resource in Imperial Valley is in it's infancy. It is acknowledged that extensive geothermal resources exist beneath the Valley floor, however its magnitude and geologic/hydrologic characteristics are not adequately known.

Extensive investigation is needed to assure that geothermal development is environmentally compatible, especially in regard to subsidence and seismic activity.

Geothermal brine is generally high in saline minerals such as boron, bromine, calcium chloride, potash, sodium chloride, sodium carbonate, and sodium sulfate. The recovery of these minerals from geothermal brine is dependent upon both production costs and market price. One chemical company has recently begun processing of calcium chloride from concentrated brine southeast of the Salton Sea. Although the potential for mineral extraction appears favorable, it has generally not been very successful. Several private corporations are presently examining the feasibility of renewing extractive operations.

ENVIRONMENTAL CONSIDERATIONS

Geothermal development has several environmental effects which warrant detailed consideration. Possible environmental impact must be identified and analyzed and measures adopted to avoid or mitigate those determined to be significant. Critical areas include:

1. Air Quality
2. Noise
3. Aesthetics
4. Plants and Wildlife
5. Water
6. Subsidence
7. Seismicity

Air Quality. Air pollution as a direct result of geothermal development may manifest itself in two ways, first by increased humidity due to released water vapor and secondly by escaping mineral vapor and gases. The cooling towers of a 70 megawatt energy production facility may introduce approximately 1.2 million pounds of water an hour to the atmosphere. This may produce "drizzle" downwind from the tower and significantly affect the local micro-climate. It is unlikely that the quantity of water vapor released by geothermal development would have a noticeable effect upon the humidity of the entire Valley area.

The inadvertant release of noxious gases such as hydrogen sulfide, and mineral vapors including mercury, could constitute both a nuisance and a health hazard. The local Air Pollution Control District should adopt stringent regulations to control possible geothermal emissions.

Noise. Significant amounts of noise may be generated during exploratory drilling, development, and operation of geothermal plants. This sound should be attenuated so that when measured at a specified distance, the noise does not exceed the permitted level. In addition to muffling devices installed within the production facility, earthen berms and vegetative screening may be used to reduce noise levels.

Aesthetics. Care should be taken to assure that drilling structures, energy conversion and desalinization facilities, and transmission structures does not present an unsighlty appearance. Vegetative screening and landscaping may serve the dual purpose of noise attenuation and beautification, shielding unattractive operations from public view.

Plants and Wildlife. Disposal of geothermal wastes to surface waters results in thermal pollution and greatly increased salinity. Both have severe consequences for aquatic life, especially increased salinity. Salinity is already a severe problem in the Salton Sea; discharge of geothermal waste would effectively destroy the fishery. If disposed of inadequately, the brine may destroy existing vegetation and drastically reduce the productive capacity of the land.

Water. The California Regional Water Quality Control Board - Colorado River Basin presently prohibits any discharge of geothermal waste into local waters. There is a possibility that the Board may remove such restrictions if the salinity and temperature characteristics of the discharged waste are within acceptable limits.

Groundwater in Imperial County is predominately of inferior quality and is generally unsuitable for domestic use. Nevertheless, additional salinization by geothermal waste must be prevented. Authorities believe that impervious soils and careful selection of reinjection zones should adequately protect shallow groundwater aquifers from contamination.

Subsidence. Ground subsidence is not uncommon in areas of groundwater mining or oil extraction. The removal of geothermal fluids is functionally similar and also results in a reduced reservoir pressure. When subsurface fluid pressure is reduced, unconsolidated or loosely consolidated sediments are compacted, resulting in surface subsidence.

The rate and extent of subsidence in an area is influenced by:

1. The geologic structure of the subsurface reservoir.

2. The nature of the fluid bearing deposits.
   a. porosity
   b. permeability
   c. density
   d. compressibility
   e. change in formation pressure

(The Resources Agency, 1973)

The lateral extent of subsidence is often defined by seismic faults which prevent or restrict fluid flow. Imperial County possesses several major and numerous minor faults, whose exact location and extent is difficult to define. Information relevant to the above mentioned is extremely limited, and accurate prediciton of subsidence is presently difficult.

Imperial Valley is characterized by continuing tectonic activity, and in fact may be experiencing continuous natural subsidence. A first and second order program of monitoring surface elevation was conducted by the County in co-operation with the State of California in 1971; a resurvey is scheduled for completion in Fall 1973. This will assist in distinguishing natural subsidence from that induced by geothermal development.

Reinjection of residual brine and cooling water may be required to reduce the possibility of subsidence. Disposal of geothermal wastes by these means are controlled by the Regional Water Quality Control Board.

Seismicity. The relationship between the extraction of geothermal fluids or reinjection and seismic activity is debated by geologists. Earthquake

activity has occured when the temperature and pressure of hot-rock/water systems have been altered. Research by W. Brace and associates at MIT indicates that warming of deep rock formations resulting from the withdrawal of geothermal fluids may actually reduce the danger of damaging earthquakes. "Creep" is the gradual movement of the Earth's surface, and serves to bleed off increasing pressure; "stick-slip" is the violent movement resulting from release of built up pressure. W. Brace asserts that by warming the deep-rock temperatures of a system, the "slip-stick" potential is reduced to "creep" motion. The likelihood of earthquakes resulting from deep fluid withdrawal or injection warrants additional scientific investigation.

POLICIES

The benefits which may accrue the County as a result of geothermal development will be largely indirect. The potential of geothermal development should be viewed in proper perspective. While cheaper energy may result, which in turn may attract industry, substantial increases in County revenue will probably not be realized over the short term.

The hypersaline brine in the northern portion of the County generally precludes the likelihood that large quantities of inexpensive water will be available from that area in the near future. Although lower salinity water is found further south, the location and extent is relatively undefined. While large scale desalinization of water is a possibility, technological improvements and a more favorable water market are required to make it economically feasible.

Environmental protection is of critical importance when considering resource development. The demand for energy appears to be insatiable, and to destroy or jeopardize other equally important resources in an attempt to satisfy this demand is thoughtlessly nearsighted.

1. Encourage the exploration and development of geothermal resources by public and private organizations consistent with protection of environmental values.

2. Secure a formal statement of policies and procedures concerning the means to incorporate Imperial County Zoning restrictions in Federal geothermal leases.

3. Geothermal resources, while potentially of considerable importance, will not be permitted to degrade the natural environment or threaten the continued viability of irrigated agriculture.

4. Participate in and promote a program to develop and centralize data relevant to the geothermal resource for the purpose of providing long-range direction based upon reliable technical information.

5. Prepare detailed development and performance standards based upon reliable technical information to assure the maintenance of an acceptable.

6. Continue to seek Federal and state funding for the purpose of developing a Geothermal Element consistent with the obvious need for a comprehensive long-range energy program.

CHAPTER IX. BIOLOGICAL RESOURCES

ISSUES

1. Loss of riparian habitat or "wetlands" resulting from flood control or water management programs is a major concern of wildlife management.

2. Loss of protective cover and habitat resulting from practices of intensive agriculture, particularly the burning of river bottom areas.

3. Degradation of water habitat by irrigation waste and untreated or inadequately treated sewage.

4. Habitat quality is threatened by urbanization and human encroachment.

OBJECTIVES

1. Recognize the fragile character of plant and wildlife resources and their dependence upon quality habitat.

2. Recognize that bilogical resource values are integral and worthwhile factors in the overall decision-making process.

RESOURCES OR RESOURCE AREAS OF STATEWIDE SIGNIFICANCE OR CRITICAL CONCERN

The State of California is charged with primary responsibility for the enhancement, control, and utilization of fish and wildlife. The California Department of Fish and Game designates habitats of great importance that are significant for the perpetuation or management of various species. These habitats are of statewide significance and include riparian habitat, fresh and saltwater marshes, tidal mudflats, sloughs and lagoons, and critical specialized habitat for other wildlife, including all rare and endangered species. Significant habitat areas also include those areas where wildlife from a large surrounding region depend on a relatively small acreage of specialized habitat during some period of their existance.

Areas of critical concern within the broader "significant habitat" areas either provide critical animal needs, such as water or nesting sites, or possess significant concentrations of rare or endangered species. Critical habitats also include areas adjacent to National Co-operative Wildlife Areas, National and State Waterfowl Refuges, and extraordinary fishery and wildlife waterways as identified by the Resources Agency as Class I Premium Waterways.

The Office of Planning and Research has identified the following areas within Imperial County which are of potential statewide significance or critical concern.

- Salton Sea
- Colorado River (Topock Gorge and Parker Dam to Imperial Dam)
- Algodones Dunes
- Imperial Reservior - Imperial Dam
- Yuma Island

The County may submit petitions to the Office of Planning and Research for the deletion or inclusion of resources or resource areas which may be of statewide significance or critical concern. Areas which the County feels may qualify for inclusion should be carefully examined and documented. The San Felipe Creek area was not identified in the First State Report and may warrant consideration.

WILDLIFE RESOURCES AND HABITAT AREAS

Plants and wildlife are of important scientific value because of their uniqueness and their adaptation to particular environmental conditions.

They exist in an exciting outdoor classroom and contribute to natural openness. This opportunity for an open, nature-oriented experience is refreshing to those faced with the anxieties of urban life.

Vegetation is important for a variety of reasons. It provides scenic beauty as well as habitat for wildlife. It also promotes maximum water infiltration into the soil, stabilizes the soil against erosion or slope failure, improves water quality, and helps to reduce flood damage. In areas of adequate precipitation nature assists in repairing environmental damage to these resources. In arid desert regions the scars of environmental damage are more visible and longer preserved.

There are generally three plant associations endemic to the region, alkali sink, Lower Sonoran Desert, and riparian or marshland. The alkali sink community, which includes arrowweed, pickleweek, and saltgrass, is found primarily in the irrigated and Salton Sea areas. The Lower Sonoran Desert association covers an extensive area of the County and includes such plant communities as ironwood, mesquite, creosote bush, and catclaw.

The natural environment includes a distinctive and highly inter-related complex of plant and animal life that can survive only under appropriate environmental conditions. Alterations imposed by man require adaptation to new conditions over a very short time and often result in unstable plant communities, introduction of undesirable plant types, and depletion of already limited forage. The best method by which to assure the protection and enhancement of wildlife resources is to provide for the protection of their unique habitat areas.

The arid nature of Imperial County limits the extent of protective cover, forage, and water available to wildlife. Ninety percent of the wildlife in Imperial County is found along the rivers, canals, and the Salton Sea.

New River and Alamo River Areas. The New and Alamo Rivers are particularly good areas for birds and small mammals. A partial list includes:

Mourning dove	Grey Fox	Raccoon
Whitewinged dove	Coyote	Skunk
Gambels quail	Bobcat	Coots
Roadrunner	Muskrat	Small rodents (Roundtail ground Squirrels, Antelope Ground Squirrel)
Gallinueles	Beaver	
Cottontail Rabbit	Badger	100 species of song-birds
Pheasant		

Intensive agricultural practices have resulted in the loss of much of the protective cover required by birds and small wildlife. Agricultural burning has occurred on river bottom lands whether part of the actual agricultural acreage or not. Protection and enhancement of birds and wildlife is dependent upon the preservation of the riparian habitat provided by these river bottom areas. Farmers are encouraged to carefully control the burning of fields so as to prevent damage or destruction of these areas.

Carp, mullet, and catfish are found in both the New and Alamo Rivers although poor water quality presently precludes more desirable species.

High concentrations of waste material reduce the amount of dissolved oxygen available in the water. Secondary sewage - treatment facilities within the County and at Mexicali, Mexico would noticeably improve the aquatic habitat.

Salton Sea Areas. The Salton Sea may regain its position as an important sports fishery if problems of increasing salinity can be overcome. Introduction of corvina, sargo, and bairdiella was very successful prior to the current high salt concentrations. This increasing salinity creates osmotic stress and results in the hatching of small fish before the development of various organs is complete. Immediate reduction of the salt concentrations in the Sea is essential if the fishery is to survive.

Wetlands adjoining the Salton Sea provide important marshland habitat for transient and wintering waterfowl of the Pacific Flyway and other water - oriented wildlife. The State and Federal Governments have set aside areas near the southern end of the Sea to protect this habitat. An egret rookery has been established in the New River delta; cattle egrets and snowey egrets numbered approximately 1000 in 1972. Over 250 species of birds may be observed in the Salton Sea area at various times during the year. The Salton Sea National Wildlife Refuge estimates that over 200,000 American widgeon, green-winged teal, and pintail ducks, 20,000 snow geese; and 8,000 Great Basin Canadian Geese utilize the area during the winter months.

The California Department of Fish and Game has adopted a list of rare and endangered fish and wildlife as required by the California Endangered Act of 1970.

Fish and wildlife of this list which are found in the Salton Sea area include the:

California Brown Pelican

California Peregrine Falcon

California Clapper Rail

Dunes Area. The Algodones Dunes provides a unique arid habitat area. The lack of water has required special adaptation by plants and animals if they were to survive. Notable is the reptile fauna which includes one of the last stands of western diamond-back rattlesnakes in California, the rare vermillion groundsnake, and the rare flat-tailed horned lizard. Some small mammals exist such as coyotes, kit-foxes, antelope ground squirrels, skunks, and a variety of mice.

Of particular interest are botanical speciments which occur in the stabilized dunes and the adjacent bajadas, providing a good representation of typical Sonoran Desert plants. Desert buckwheat is a shrub which can reach four or five feet in height and survive in areas of shifting sands. This species is on the California Native Plant Society's list of rare and endangered plants. The Spanish Needle, Silver-Leaved Sunflower, and an unusual desert croton are found in California only in these dunes.

Colorado River Area. The Colorado River provides valuable riparian habitat along the Cibola, Palo Verde, Imperial, and Yuma Divisions. Information regarding the range and wildlife along the Palo Verde, Cibola, and Imperial Divisions is presently incomplete. A study by the California Department of Fish and Game on the fish, wildlife, and vegetation along the Imperial Division will be available in 1974.

It is expected that the plants and wildlife identified in this Division is also representative of the Palo Verde and Cibola Divisions.

Imperial Division. The Imperial Division is presently a relatively unspoiled natural stretch of the Colorado River and provides valuable scenic, recreational, and wildlife resources. Located in the Lower Sonoran Desert Life Zone, it is distinguished by it's extraordinarily high temperatures and minimal precipitation. The riparian area is composed of five main plant communities, including cattail and tule marsh; cane carrizo; cedar salt mesquite, and arrowweed; alkali flats; and limited stands of willow and cottonwood trees. These communities mix to varying degrees, each providing habitat for a variety of wildlife. Initial reconaissance studies have identified 39 species of mammals, 205 bird species, and nearly 50 reptiles and amphibian species in the Division. These include the endangered Yuma Clapper Rail, herons, beaver, muskrat, deer, fox, bobcat, and ringtail cat to name but a few. The pending report by the Department of Fish and Game will provide a more precise accounting of the wildlife value of this Division.

Yuma Division. The Colorado River - Yuma Division has basically two types of habitat; main channel and backwater. The main channel is characterized by slow moving, turbid water with silt-sand bottom and frequent sandbars. It provides food and cover for channel catfish, flathead catfish, threadfin shad, and soft-shelled turtles. Principal gamefish include channel catfish, flathead catfish, yellow bullhead, largemouth bass, black crappie, redear sunfish, and bluegill. A marine species, striped mullet, is abundant in the river and local drainage canals but few are taken by anglers.

Backwaters result from the meandering river and include the quiet water next to the river banks, secondary channels, and side ponds. These off-channel waters support abundant stands of sedge, rush, cattail, carrizo cane, cottonwood, mesquite, arrowweed, seepwillow, saltcedar, willow, and grasses as well as submerged aquatic vegetation.

The immature forms of flies, caddisflies, dragonflies, and damselflies, which consititute a significant portion of the diet of young gamefish, are found in these slow, quiet, shallow waters. Threadfin shad, the primary forage fish for local gamefish, depend upon this habitat. Secondary food sources such as worms, frogs, and freshwater shrimp are also found here. Vegetation, brush, old burrows, logs, stumps, boulders, and undercut banks found in these backwaters provide critical protective cover for gamefish, without which they would be subject to heavy predation. Backwater area therefore provide habitat for food, cover, and reproduction to area gamefish.

The shallow sandbars and shoals are commonly vegetated by common tule, cattail, sedge, rush, smartweed, and grasses. Along the rivers edge and extending into the floodplain are found mesquite, saltcedar, saltbrush, and willow. This vegetation provides cover for nesting, roosting, feeding, resting, and escape for birds and other wildlife.

Some burro deer remain in the area and it appears that their numbers have stabilized. Wild burros and horses may also be observed. The Yuma Mountain Lion is very seldom seen and is thought to be near extinction. California bighorn sheep are found in the mountain areas and are classified as rare by the Department of Fish and Game. The Colorado River is of somewhat limited importance to the bighorn sheep as they do not often leave the protection of the steep mountains except during periods of severe drought.

Only two species of upland game mammals exist, the cottontail rabbit and the backtailed jackrabbit. The cottontail is dependent upon riparian and flood-plain vegetation. The protective cover provided by brush is very important for shelter and escape. The jackrabbit can exist under drier conditions and is less dependent upon the river for its survival.

Furbearers and nongame mammals include beaver, muskrat, raccoon, skunk, grey fox, badger, and kitfox. The beaver and muskrat are predominatly river bank dwellers and subsist mainly on the bark of willow and cottonwood. Other non-game mammals include coyote, bobcat, deermouse, and the kangaroo rat.

Upland game birds in this division include the Gambel's quail, mourning dove, and white-winged doves. These birds depend heavily upon dense thickets of riparian habitat for escape, protection, nesting, and food. The legume family, typified by mesquite, is an important source of food. Proper habitat manipulation could provide a significant increase in quail population. During the spring and summer months mourning doves and white-winged doves nest, feed, and rest in the area. White-winged doves commonly roost and nest in mesquite, saltcedar, cottonwood, and willow. They are both primarily grain - feeders although the fruit and seeds of some trees, shrubs, and herbaceous plants constitute a large portion of the white-winged dove's diet. Water is an absolute requirement in the breeding habitat of white-winged doves and is provided by the Colorado River.

Migratory waterfowl utilize the division primarily between the confluence of the Gila River and a point about one mile upstream from Yuma, Arizona.

Common dabbling ducks include the cinnamon teal, green-winged teal, shoveler, pintail, and widgeon. Divers include the bufflehead, redhead, and ring-necked ducks. American Mergansers are also common. While the slow moving river provides a variety of plant and animal forage, particularly for the diving ducks, the nearby fields attract many of the dabbling ducks. Coots, songbirds, and a variety of non-game birds such as herons, egrets, and ibises are also common. Three species of geese utilize the area. White-fronted geese pass through in October and early November, followed by snow geese and Great Basin Canada Geese.

The California Department of Fish and Game list fish and wildlife species in the area as rare or endangered, including the:

California Clapper Rail	Colorado Squawfish
Yuma Clapper Rail	Humpback Sucker
California Black Rail	Bony Tail
California Yellow-Billed Cockoo	California Bighorn Sheep (Mountains of Imperial Division)

The Lower Colorado River Management Plan-Yuma Division is a program of the Bureau of Reclamation which is intended to prevent flooding and destruction by meandering river channels and to reduce water losses. Proposals include dredging the low-flow channel to increase it's capacity, clearing of strips of phreatophyte and hydrophytes, and stabilizing the new channel banks with dredge material and rip-rap. This project is approximately one-third complete but has been halted because of environmental considerations raised by the Arizona Department of Game and Fish and the California Department of Fish and Game.

Channelization and vegetative control will result in drastic changes in the habitat and wildlife of the area. Existing backwater, marsh, and sandbar habitat will be eliminated. The straightened rip-rapped channel will do little to enhance the aesthetic appeal of the area or to provide wildlife habitat. With the elimination of suitable habitat, the fish and wildlife of the area will decline substantially.

The County should carefully analyze its objectives regarding the east county area and the potential public benefit which may accrue from this type of project. Various stretches of the Colorado River have been channelized and stabilized in the past with significant effect upon biological resources. These wildlife values are important considerations. The County should provide input to the federal decision-making process regarding its position in this area. The Imperial Division remains as one of the most scenic stretches of the Lower Colorado River and should be protected from projects of this type.

POLICIES

1. Identify, plan, and program for the protection of areas of unique value in their natural state for educational, scientific, ecological, or aesthetic purposes.

2. Provide for the protection and enhancement of wetland or specialized habitat which provides water, forage, protection and resting area for Pacific Flyway waterfowl and other wildlife.

3. Development practices that upset natural habitat in wetlands or riverine areas should be controlled to minimize erosion and maximize beneficial vegetative growth.

4. Restrict the type of development permitted on floodplains both for the protection of public health and safety and to provide recreational open space and wildlife habitat.

5. Agricultural operations are encouraged to maintain or protect areas of natural habitat where terrain or soil is not conducive to agricultural production. Burning of river bottom adjacent to agricultural land but not in production should be carefully controlled.

6. Encourage and support objectives and policies of the California Office of Planning and Research and the Department of Fish and Game for the protection of rare or endangered species by identification, education, habitat conservation, and effective management programs.

RIVERSIDE COUNTY

SAN DIEGO COUNTY

MEXICO

ARIZONA

CALIFORNIA BROWN PELICAN
CALIFORNIA PEREGRIN FALCON
CALIFORNIA CLAPPER RAIL

BIGHORN SHEEP

BIGHORN SHEEP

BIGHORN SHEEP

BIGHORN SHEEP

BIGHORN SHEEP

CALIFORNIA CLAPPER RAIL
YUMA CLAPPER RAIL
CALIFORNIA BLACK RAIL
CALIFORNIA YELLOW-BILLED CUCKOO
COLORADO SQUAWFISH
BONYTAIL
HUMPBACK SUCKER

LEGEND

- AQUATIC HABITAT
- MARSHLAND HABITAT
- RIPARIAN HABITAT
- LAND HABITAT
- BIGHORN SHEEP CONCENTRATION
- RESOURCE OR RESOURCE AREA OF POTENTIAL STATEWIDE SIGNIFICANCE OR CRITICAL CONCERN
- URBANIZED AREAS

FISH AND WILDLIFE LISTED ARE RARE OR ENDANGERED.

BIOLOGICAL RESOURCES

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SCALE IN MILES

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